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The ARMOUR ENGINEER

VOLUME XXII
No. 1

NOVEMBER
1930

Published Quarterly by the College of Engineering
Armour Institute of Technology ❧ *Chicago, Illinois*
Member of Engineering College Magazines Associated

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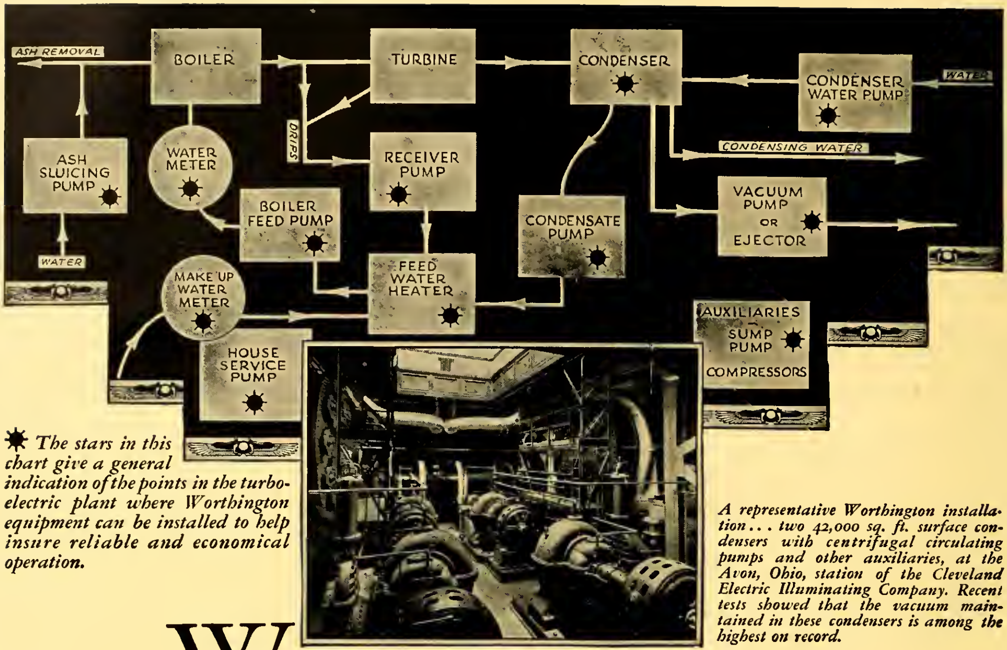

✷ The stars in this chart give a general indication of the points in the turbo-electric plant where Worthington equipment can be installed to help insure reliable and economical operation.

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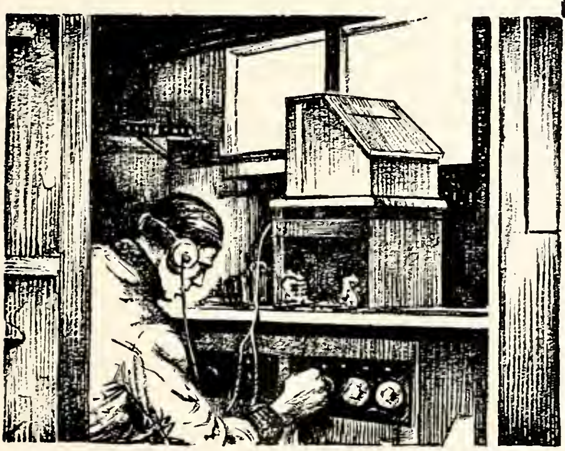

Above: Blasting to determine a possible oil structure by geophysical prospecting (from an actual photograph).

Left: Delicate instruments record the earth vibrations initiated by explosives.

As an engineer, you should know more about explosives. Write for a sample copy of The Explosives Engineer, a monthly magazine which records the growing use of explosives in modern civilization.

H-6

ON GUARD!

Out in mid-rink, flying skates cut the glassy surface of the ice into powder amid the clatter of sticks and the hoarse, inarticulate cries of human beings in combat. Back and forth goes the puck, now dexterously propelled down the side-lines by a fleet forward, now shuttled rapidly to and fro amid a tangled mass of sticks and legs. Yet fast as it moves, it never eludes the watchful eyes of the two heavily-armored huskies who tend the goals. On guard, ready to thwart disaster with stick, skates, or any part of his body, the good "goalie's" work is ever vital, and often spectacular.

In a large organization like Westinghouse, there is need for a number of such expert "goal tenders." Occupying positions in the Accounting, Legal and Contract Departments, they carry on quietly their important work of guarding the resources, patent situations, and contractual relationships of the company. And among them may be found many younger college men, like those whose pictures appear on this page, who have found in this work an opportunity to secure recognition and worthwhile reward.

S. F. Henderson
Armour Institute of Technology, 1926
Contract Administration

G. C. Saltzman
Carnegie Institute of Technology, 1923
Patent Department

E. H. Hornbarger
Virginia Polytechnic Institute, 1921
Contract Administration

W. F. Swezey
University of Kansas, 1923
Patent Department

Among the important pieces of electrical work handled by Westinghouse in recent years may be mentioned the following:

Cascade Tunnel Electrification, Great Northern Railway;
Network Protector Installation, Chrysler Bldg., New York;
Hydro-Electric Generating Equipment, Coolidge Dam, Arizona.

Westinghouse

Please mention The Armour Engineer

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

VOLUME XXII NOVEMBER, 1930 NUMBER 1

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Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.

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A Night View of the New Merchandise Mart—the Largest Building in the World

The
ARMOUR ENGINEER

VOLUME XXII. NOVEMBER, 1930 NUMBER 1

The Furka and Grimsel Passes of Switzerland

By **George L. Scherger, Ph. D.**

Professor of History and Political Science and Head of the Department

Of all the countries of the world Switzerland deserves the palm for natural beauty. The Almighty has showered his blessings upon this little land. Scarcely a square foot can be found that is not replete with the beauty of scenery or the interest of historical associations. One can well understand why Swiss people seem never to feel fully at home anywhere else but in their beautiful country. You may find elsewhere mountains equally high and grand, such as the Canadian Rockies, but no where else have nature and history and civilization been brought together in such a remarkable way as in Switzerland.

No scenery in Switzerland exceeds in grandeur that of Lake Lucerne and the Furka and Grimsel Passes. Suppose the tourist starts out from Lucerne. He will go into rhapsodies over this wonderful city with its famous old wooden bridges decorated over five hundred years ago with pictures illustrative of the exploits of her citizens. He will admire the great Thorwaldsen's masterpiece, the famous Lion of Lucerne cut into the rock by his mighty chisel in memory of the terrible massacre of the Swiss Guard of King Louis the Sixteenth of France on that fatal tenth of August, 1792, when the mob attacked the Tuileries. He will not fail to attend one of the daily concerts given on the mighty organ in the venerable cathedral, and will enjoy a walk on the beautiful esplanade which encircles the lake, gazing into the attractive show windows of the many stores that lie along this promenade.

Taking the boat at Lucerne, the tourist may enjoy for several hours a trip on the beautiful lake of Lucerne, the eye drinking in at every moment scenery of such grandeur as to convince even the most confirmed skeptic of the existence of the Supreme Being who made this all. It is advisable to get off the boat at Vitznau and take the Funicular railroad (which by the way, is a Swiss invention) up the magnificent mountain known as the Rhigi, from the top of which you may obtain a view of the Bernese Oberland which beggars description. Again taking the boat at Vitznau you soon reach the historic Tell country. The Axenstrasse passes along the edge of the lake and a trip along this famous highway can be compared only with the famous Corniche drive from Nice to Monte Carlo in the French Riviera, or with the famous Amalfi drive.

The Tell Chapel attracts our attention, tiny though it may be, for we know that at Tells Platte, Wilhelm Tell, the great national hero of Switzerland, jumped from the ship on which he was held prisoner by Gessler, the Austrian tyrant, onto the land and to freedom. Our boat continues its journey until we reach Fluelen where we take the train through the sublime Gotthard Pass. Our train climbs higher and higher. Four times it encircles the pass, and each time we are many hundreds of feet higher than before. Our breath is almost taken away by the sights that greet our eye. Finally, we have reached Gross Goeschenen where once more we board the train, this time a narrow gauge train, and climb still higher. We hear the mighty roar of the cataract passing underneath the Teufels Bruecke

Nestling among the mountains of Switzerland, lies Lucerne, one of the most picturesque towns in all Europe.

(devils bridge) nearby. Alongside this cut in the rock is the inscription commemorating the mighty military exploits of the Russian general, Suwaroff, who led his army up to these dizzy heights to fight the French. We pass the barracks where each summer for a few months the strong and brave Swiss boys and men receive their military training and in these mountain crags observe the mighty bastions created by nature, which protect Switzerland from Italy to the South. At length we reach the little village of Andermatt with only a few hundred inhabitants. But what a delight to spend at least a night in one of the very good hotels in this little village. We are now eight thousand feet above sea level in one of the highest villages in the world and yet around us are mountain peaks several thousand feet higher which we will still climb on the morrow.

We find the splendid auto busses (which everywhere in Europe are called char-a-bancs) under the management of the postal authorities and we feel that we are in safe hands, because nowhere else will you find such expert and reliable chauffeurs. Higher and higher we go. The journey lasts all day. There are many sharp turns in the roads that zig zag among these mountains. We are surprised at the traffic at such a height, for we pass numerous char-a-bancs and private cars from all parts of the world. However, only the most experienced driver should venture upon this road for the slightest misjudgment of a few inches with reference to the edge of the road might plunge one into the abyss. Time and again we hold our breaths as we gaze down where thousands of feet below us lies the valley. Perhaps in the summer we will even pass detachments of soldiers, poor fellows who must have been tramping for hours their weary way up these perilous heights. Now and then we strike a pretty little village. Often we see herds of sheep or cattle sent up here for pasturage.

We now reach the highest part of the Furka Pass, so called because it is shaped like a fork. We get out of our char-a-banc for half an hour or so to stop at the inn where we are interested in observing the motely groups of tourists from all parts of the world. We have come to one of the most celebrated glaciers in the world, the Rhone Glacier. A way, extending perhaps half a mile, has been cut into the Rhone Glacier into which we may walk. The wonderful play of colors, especially the pale blues and greens, is most impressive. At the foot of this glacier, which never melts even in the hottest weather, a little stream of water breaks forth. It is the beginning of the Rhone River. A short distance brings us to the little village of Gletsch where we enjoy a splendid meal.

The town of Interlacken lies almost at the base of Jungfrau Mountain.

From here we continue our journey in the afternoon over another part no less interesting which, because of its dark threatening nature, is called the Grimsel. How threatening and forbidding the high mountain walls appear! Here is a little lake made by the rivulets coming from the highest peaks in a region of everlasting snow ten thousand feet above sea level. The mountains seem alive. They speak a voice of their own. In this sublime region peace reigns—a peace that is almost oppressive and is broken only by the tinkling of numerous brooks and rivulets descending from the highest peaks and sometimes mighty waterfalls crashing down the mountain sides.

The intelligent Swiss people are taking advantage of the almost unlimited power which nature furnishes here, and great engineering enterprises are being carried out to utilize the water power which for ages has gone to waste.

At length we reach the beautiful Brienzer Sea, which we cross by boat to reach the pleasant and attractive little town of Meiringen where we continue our journey for an hour longer until we reach Interlacken.

Nowhere in Switzerland, or anywhere else, do we find such gorgeous mountain scenery. The queen of all these mountains is the "Jungfrau" ("Virgin") so called because of the whiteness and purity of its

(Continued on page 39)

In the foreground are shown the char-a-bancs that are used for sightseeing. In the background is the Rhone glacier.

The Power Industry

By C. T. Link, Jr., '31

Student in the Department of Mechanical Engineering

POWER, that staunch servant of mankind, may well be called the keynote of our modern civilization. That which wrought todays commonplace from the impossible of yesterday; that which immeasurably elevated the standard of living; that which facilitated a higher learning and scientific research; and that which advanced the whole scheme of civilization far above a level previously attained, has been the application of power.

The inestimable value of electrical power to man was recognized by Robert Henry Thurston over fifty years ago. He hoped that some future genius would convert the energy of coal directly into electricity and thus create a means for the generation of this wonderful power that would be commensurate with our extensive use of it. The realization of that ideal depends upon important discoveries in atomic physics and remains apparently quite remote. Meanwhile, however, the world has witnessed the great evolution of steam power plants, hydro-electric installations, and Diesel units, from small beginnings to leaders of modern civilization.

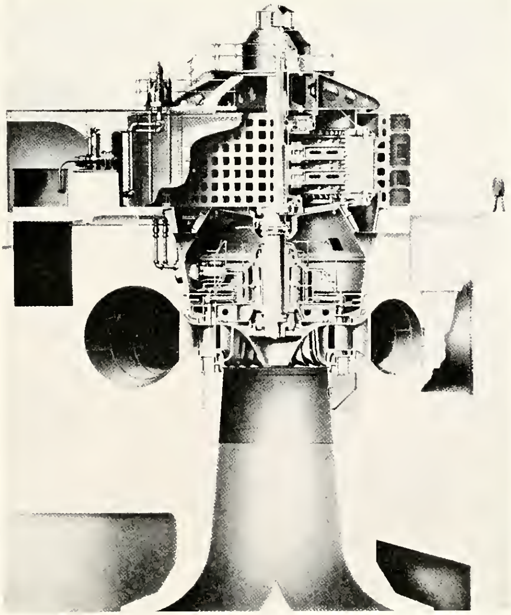
Although many other means for the production of electricity exist, inherent qualities which render them commercially impractical are generally present. A novel attempt to obtain electrical power at low cost is the thermal-couple tube experiment being conducted by Professor Claude in the gulf stream off the Cuban coast. The successful operation of the tube depends upon an appreciable temperature difference which exists between the lower levels and the surface of some bodies of water. This requirement considerably reduces the scope of the invention in the power field.

An unusual plan to generate power utilizes the fusion heat of ice that is present in water at 32° F. or above. A quantity of insoluble volatile hydro-carbon is placed in contact with water in a boiler at a temperature below freezing. The hydro-carbon evaporates upon absorbing the latent heat from the water, and expands in a condensing turbine, after which it re-enters the boiler and completes the cycle. However, no such plant has been installed and temperature requirements restrict its field of application to polar regions.

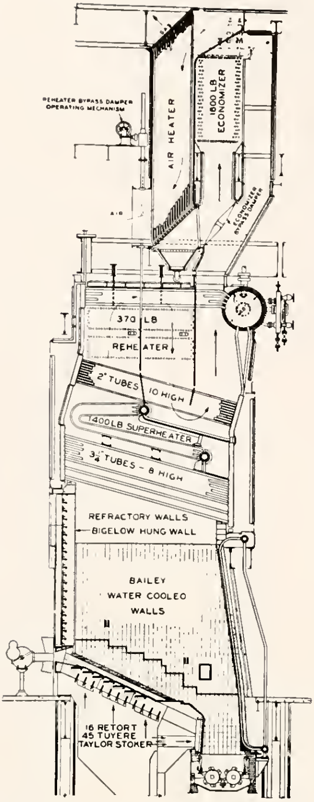
Attempts to harness the more obvious sources of energy such as the wind, tide, waves, sun's rays, and others, have met with varying degrees of success. Windmills have been used since the time of the Romans but the necessity of expensive storage equipment renders them impractical for the generation of electricity. Extremely high tides in some locations offer oportunities for successful hydro-power stations but this development has not been extensive. Wave and sun-ray power work has been merely experimental. What appears to be a practical hydro-electric project is one designed to utilize the 1,000 foot drop between the Mediterranean and the valley of the Jordan. It is estimated that 500,000 kilowatts could be obtained by conveying the water to a station near Beisan. Such are the more remote possibilities and experimental means for the production of power.

While internal combustion engines using light distillates and gas have never produced electrical power to any great extent, the Lorenzen internal combustion gas turbine gives promise of success in this field. Doctor Lorenzen has mainly overcome the outstanding difficulties encountered in building such a machine. He has obtained a design that will withstand the high temperature by the novel use of compressed air to cool the hollow rotor blades. It only remains for more research to improve material and design to permit larger capacities.

Diesel engineering continues as an important factor in the power field with the progress made in the cost, space requirements, and capacities of large Diesel-electric units. An example of latest design is the 24,000 horsepower standby and peak load station at Henningsdorf, near Berlin, Germany. The two units of 11,700



A cross sectional view of the 70,000 H. P. hydro power generating unit built for the Niagara Falls Power Co.



Cross section of the 15,000 Sq. Ft. 1,400 Lb. boiler at the Edgar Station showing a modern type of steam generating equipment.

horsepower each are remarkable for their lightness and efficiency. Diesel-electric units are feasible for isolated stations up to the point where the combined power of the plant exceeds 3,000 kilowatts. It is then a question of water and fuel supply, and if both are abundant, the steam plant may prove to be the better investment. If the water is not good, Diesel plants composed of large units may operate at a saving up to 5,000 kilowatts. Beyond this limit it is found advisable to bring in transmission lines, even from considerable distances.

During the last few years the Diesel has found a large application in standby and peak load service for the large networks of power transmission. Quick starting, made possible by rigid maintenance, small investment, and efficient operation, permit application in this capacity. Diesel power for peak load service is somewhat curtailed by the use of obsolete steam power plants. Although starting and operating heat losses may be high with the obsolete steam plant, a Diesel investment is often more expensive. Additional competition is effected by the efficiency characteristics of modern steam power installations which frequently permit operation at the peak with a unit cost less than that incurred with a Diesel addition. Diesel power has of course made more progress in Europe because of the high cost of coal there, but its use in the United States can be expected to increase materially if further substantial improvements are made.

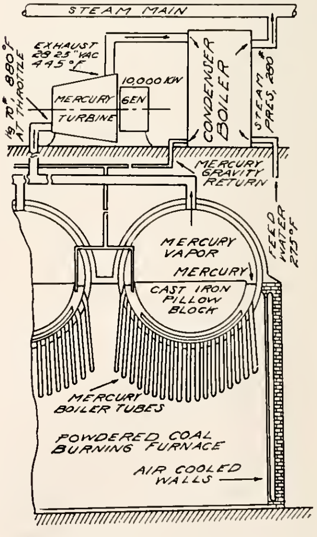
It has been shown that hydro-electric power is a constantly decreasing percentage of the total electrical power generated in this country. This condition is due to the economies effected through super-power, the increased efficiency of steam power plants, and the tremendous cost of hydro-electric installations. An interesting phase of hydro-power is the combination of hydro-electric and steam-electric plants. Limited stream flow constitutes a fundamental limitation to the load factor of a hydro-electric plant, but combined hydro and steam power may remove such a limitation by enlarging the steam-electric plant. The increase in capacity of steam-electric units has considerably lengthened the requirement period of starting from cold. A hydro-electric station is an ideal supplement to these large steam-electric units because the starting time is practically negligible, permitting of a reduction in service insurance steam capacity that must be kept in operation. The operation of peak load steam-electric stations is very expensive and no compensating returns are realized during base load service. A hydro-electric station, however, will carry the peak load at comparatively low operating cost during low stream flow, and the base load at very low cost during high stream flow. The advantages of this arrangement depend upon the ability of the steam-electric plant to assume the base load as necessitated by available stream flow.

The schedule of combined steam and hydro plants depends upon characteristics of the stream supplying the hydro-electric power. When the stream is subject to great variations of flow and very limited storage capacity is available, the hydro-electric plant supplies the base load during high stream flow and the peak load during low stream flow. The remainder of the load is assumed by the steam-electric plant in each case. At developments utilizing nearly constant stream flow, the steam-electric stations supply all demand above a constant base load generated by the hydro-electric plant. Under certain conditions, the use of off-peak power may be used to pump water to a high reservoir and thus eliminate the steam-electric reserve.

While there have been no recent outstanding developments in the theory or utilization of water power, constant effort has been made to improve the design of existing hydro-electric equipment. Turbine and Pelton efficiencies have reached 94 and 85 per cent respectively, and extensive model testing may produce further improvement. There are many large and fine hydro-electric installations, but some major change in design is needed to materially reduce cost and remove the barriers to a more complete use of available water power.

Regardless of its extravagant use of fuel, the steam power plant continues to generate a larger portion of the total electrical energy supplied each year. This continued progress is the result of active research in every phase of heat power engineering. Central station heat rates have been reduced to below 13,000 B. t. u. per kilowatt hour. A large portion of this gain is due to improved boiler plant equipment which has registered a

(Continued on page 30)



Diagramatic sketch of the main elements in the 10,000 K. W. mercury vapor plant of the Hartford Electric Light Co.

The Relation of Chemistry to the Refining of Oil

By Henry Levin, '33

Student in the Department of Chemical Engineering

THOSE cognizant of the forces about us know that to science and industry, hand-in-hand, do we owe the material comforts of the twentieth century. All about us are marvels which the mind of man has devised, marvels which would have strained our credulity twenty-five years ago—the automobile, the ocean liner, the airship, the deluxe apartment, the skyscraper. Where shall we begin in an effort to picture the science-industry combination which has been so effective? What industry is so superlative an example of the coördination of science and industry, or more typifies our ultra-modern civilization than the petroleum industry? Let us survey in conjunction, then, the nucleus of this ramified colossus—the refinery—and the science with which it is so closely associated—chemistry.

Chemistry is the science which studies the composition of substances, their properties, and their transformations. It may therefore be applied profitably to the utilization and processing of any crude material. A realization of this fact has removed the stigma of stagnancy from many an industry. A hundred years ago the iron and steel industry was scarcely more than an obscure art. Today, having allied itself with metallurgical chemistry, it has grown to stupendous proportions. Similarly, after its inception eighty years ago by the chemist, Young, the refining process threatened to sink into a condition of rutted procedure. But as perplexing problems were encountered time and again, which only chemistry could solve—and did solve, the dependence of a flourishing refining industry upon chemistry became greater and more apparent, and the petroleum industry renounced its self-sufficiency to embrace like a contrite child this fundamental science of matter.

As to how chemistry has influenced the metamorphosis of this gigantic industry—its history is a romance replete with pages which sing the achievements of chemists. Some of these pages shall be delved into.

An incident which aptly illustrates the general application of chemistry to the petroleum industry is that of the "skunk" oils of the Petrolia, Canada, and Lima, Ohio, fields. The wells were prolific producers, but the oils were found to be saturated with sulfur compounds of extremely objectionable odor. What was worse, in transportation many things in proximity with the oil were permanently drenched with the disgusting stench of the "skunk" oil. No process known could satisfactorily be employed to deodorize the crude oil; abandonment of the wells became imminent, since few indeed were the refiners brave enough to risk offense of the public nostrils. Shortly afterward, however, Herman Frasch developed his copper oxide process for sweetening the oil. The crude petroleum was agitated with the oxide, whereupon most of the sulfur was then extracted in the form of a precipitate of copper sulfide. The sulfide was then calcined to recover the copper oxide. The sweetened oil compared favorably with the best of the low sulfur crudes, and yielded products whose quality paid everlasting tribute to Dr. Frasch and the science of chemistry.

Each year the American Chemical Society conducts a prize essay contest for college freshmen. Students are allowed to write on one of the following items: Chemistry in Agriculture, Chemistry in the Home, Chemistry in Industry, Chemistry in the Enactment of Life, Chemistry in Warfare, or Chemistry in Medicine. Prizes amounting to one thousand dollars are awarded in each of these divisions. Last spring the winners of the 1929-1930 contest were announced and a student of Armour received the first prize for his essay in the Chemistry in Industry division. His interesting article on the Petroleum Industry is presented here.

Crude petroleum is a mixture made up almost entirely of organic compounds known as hydrocarbons. By fractional distillation it may be divided into fractions of varying volatility, each of which possesses its own commercial utility. Previous to tht advent of the internal combustion engine in the early part of the twentieth century, it had been the attempt of refiners to ketp the quantity of lighter (gasoline) distillate at a minimum. This product had been less than worthless; no possible use had been found for this highly inflammable material, and most refiners resorted to the wasteful expedient of burning it in the open field. But with the development of the automobile, gasoline became the most important and desired of petroleum fractions.

Soon the demand for gasoline threatened to exceed the supply, while all efforts to "stretch" the output were inevitably accompanied by a lowering in the quality of the commercial commodity and an excessive production of the undesirable heavy fuel oil. In 1912, when the situation was most acute, the concentrated efforts of research workers effected a solution by inaugurating the system of cracking—or decomposing heavy petroleum fractions into lighter constituents.

The decompositions of the heavy molecules of petroleum are reactions of the "reversible" type. Also, it was found that they were accompanied by an absorption of heat and usually a change in volume if gaseous compounds were involved. Therefore the search for the best conditions of cracking cheap fuel oil or gas oil fell naturally within the domain of the physical and thermal chemist. The complexity of the problem, however, is illustrated by noting a few of the possibilities in the breaking up of dodecane, a characteristic compound of the illuminating oil (kerosene) fraction:

$$2C_{12}H_{26} = CH_4 + C_{23}H_{48} - 500 \text{ cal.}$$

$$C_{12}H_{26} = C_2H_2 + 2C_5H_{12} - 47{,}000 \text{ cal.}$$

(Continued on page 36)

Cultural Aims In An Engineering Education

By Professor C. I. Palmer

Dean of Students, Professor of Mathematics, and Head of the Department

ALL successful men have an education. Some get it without going to school and some get it after going to school. The college should help somewhat. "It is what people do when the pressure is removed that shows whether or not they are educated."

I conceive of education to be the calling forth and training of all the physical, moral, intellectual, and spiritual faculties commensurate with the capacity of the individual. It is well done when the individual is well balanced in all these characteristics. It may be poorly done—a "highbrow" is a man educated beyond his intelligence.

The actual benefit of a college to young men will not come altogether from their studies here, from the curriculum set up for them; but will come because of their change of environment, from coping with new conditions, from each one matching himself with those who are his equal or superior. These are the things which work for growth; and ultimate development is the integration of one's present and past thoughts, actions, and deeds. A man's past is a part of him; so are his friends and connections. Hence he should build up a *present* which will become a proper background—a good past.

A noted consulting engineer says: "The student engineer should receive more cultural and inspirational training." Our young men are preparing to be engineers in the field of the physical sciences. To be human engineers and to be engineers of spiritual rather than material things are of equal or greater worth in furthering human welfare. The achievements of the past, in peace and in war, have drawn the attention of the public to the ability of our great engineers in directing and guiding human endeavor. It is evident that these men are engineers in the spiritual realm as well as engineers of material things.

It is time that the engineer should not only appreciate this but should realize that the training in college is only the foundation for further education gained by experience and study during the remaining years of life. College is finished at commencement. Thereafter the graduate may order his education more to his personal liking. If he is to become a "full man," he must never cease to build for himself upon his college foundation. "The development of greater social insight and a larger sense of social responsibility should be a definite objective of the engineering profession if it is to gain recognition for more than its technical proficiency."

Dean C. I. Palmer

The essential aim of a technical education is not so much to impart technical knowledge to the student as to furnish training which will enable him to understand and investigate the conditions which surround a problem, to determine the fundamental principles on which its successful solution depends. So with those phases of education that may be labeled cultural, the aim should be to help one to have a broad outlook on life; to enable one to meet men in social and civic matters, to understand and direct human relations, to extend his influence in public life, to claim his due share of leadership, and to discharge more adequately his function in society at large; to give him confidence and assurance; to show him the necessity of laying hold on the universal spiritual forces that so greatly assist in placing one in a commanding position among men; to help one to truly live. To quote from President Hoover: "The engineers have come into a wider responsibility than solely the application of their technology. To them comes more and more the human problem of relations between employer and employee, the relations between the producer and consumer. The mind trained to regard the consequences of action in their human results bids fair to be the largest of the contributions of the profession to progress."

At present when such vast numbers of our young people attend college, and when, at least, a large majority of these are eager to obtain all the benefit possible from the training offered there, it behooves the college to strengthen its offerings in every way possible and to guide the student with the utmost care during his college life. By care and guidance, the student who is thoughtful and serious minded may be assisted in rounding out his character, his morals will become better grounded, he will realize with a greater degree of certainty that there is a spiritual universe and he will recognize the effects of immutable laws which the human mind can and does formulate in part and label laws of nature. By proper assistance his personality, that complex something which is composed of so many intangible attributes, may be greatly improved; and, ultimately, he may gain to some degree that happy equilibrium of power and restraint, that calm and radiating energy, that constitutes poise.

(Continued on page 28)

Some Notes On the Aims of Engineering Education

***By* Professor John C. Penn**

Dean of Engineering and Professor of Civil Engineering

THE aims of engineering education, the curricula, the costs, the personnel of students and faculty of technical colleges, and their end products, the graduates and engineers, were thoroughly studied by the Board of Investigation and Coordination of the Society for the Promotion of Engineering Education during the years 1923-1929. The first volume of 1,039 pages appeared lately and the second volume will be distributed shortly. Although there is plenty of room for improvement, as a whole the engineering educators were well satisfied with the methods employed and the results of their efforts. Mr. W. E. Wickenden, the Director of the Investigation, made a thorough study of European methods and the reports on his findings on engineering education across the Atlantic are most interesting and enlightening. He calls particular attention to our lack of trade schools and intermediate schools for engineering. In Chicago, with the possible exception of the Washburne School and the short courses in the technical high schools, there is but one trade school. This one school makes no pretense of preparing boys and girls for entering schools of higher education; it is a trade school pure and simple. I can remember distinctly the statement made at its dedicatory exercises that it was hoped that in the future it might not "degenerate" into a technical college such as had been the history of the Armour Institute of Technology! We need trade schools. Every carpenter foreman of any account bemoans the lack of real wood workers and real plasterers. Every book-binder finds it increasingly more difficult to find young men willing to be trained in this art. The statement still holds good that only among the immigrants will you find craftsmen who can do a real honest job, and who enjoy turning out a fine piece of workmanship. With our restrictions on immigration the employers of craftsmen will have a real problem on their hands in a few years.

A large proportion of the graduates from engineering colleges find their niche in positions of draftsmen, surveyors, inspectors, salesmen, electricians, armature winders, custodians of city schools, detailers, minor positions on construction, etc. The career of engineering in independent practice is open to only a small number of students. The consulting engineer is of the true professional type. Between him and draftsmen is an enormous gulf, yet we in the U. S. give identical education in our technical colleges to both. As they are, the American technical colleges occupy a level between that of the Arts and Science Colleges and the truly professional college of law, medicine, and divinity. In Europe, especially so in the Netherlands, this state of affairs does not exist. The Technical College at Delft is for the training of Engineers, and only its graduates, and those who can pass the state examinations, are permitted to call themselves "engineers" and prefix their names with Ir., i. e., "Ingeneur." Only the exceptional high school graduate can gain admittance and the course extends over six years. Below this are three technical schools that offer four year courses, entered directly from high school, where young men are trained for technical positions. The graduates of these intermediate grades are not engineers and are neither so called nor so recognized. They are known as draftsmen, mechanicians, "electricien," surveyors, etc. Social status enters everyday life there much more than it does in this country. Perhaps we could not tolerate such classification, but as an illustration, an Engineer in the Netherlands holds the same rank socially, i. e., the highest, as the Physician, Surgeon, Lawyer, or Theologian. Those of the intermediate schools do not; they are of the "middle" class. If through economic circumstances, a graduate engineer of Delft cannot find a place in his native land, he either seeks a governmental position in the Colonies or emigrates to the United States. It would never do to lose caste. Disregarding the social side of the question, there yet remains the need in this country for such intermediate education. Our evening schools are sufficient legitimate evidence of this need, and the "schools" that are advertised in our popular magazines are reaping an easy and often illegitimate harvest in trying to answer this need.

Dean John C. Penn

But we are striving in the United States and making headway. The engineering societies are doing the country and the engineers a great service in raising the standards and ethics of the profession, and the Society for the Promotion of Engineering Education has done valiant work in pointing out some of our shortcomings in the field of engineering education.

In discussing the aims of engineering education, the definition of engineering may well be considered. Engineering is a very comprehensive term and many attempts have been made to give a short definition to be both inclusive and exclusive,

(Continued on page 34)

Seeing Colorado with the E. C. M. A.

By A. J. Lenke, '31

Student in the Department of Fire Protection Engineering

THE 16th, 17th, and 18th of last October shall always hold a most glorious place in my heart, for they were days packed with work and play as no other days have ever been before. The occasion of such a grand combination of business and pleasure was the Tenth Annual Engineering College Magazines Associated Convention, held on the campus beautiful at the University of Colorado at Boulder. My only wish in looking back over the days spent there is that every student at Armour could have made the pilgrimage with me to Colorado.

The main body of delegates, representing twenty-three engineering magazines from the largest technical schools in the country, left Chicago at midnight, October 14th. After two nights and one day of travel over the plains of Illinois, Iowa, and Nebraska, we arrived at Boulder early Thursday morning, October 16th. It had snowed the night before, and so the campus was a scene of white upon our arrival.

As we descended from the train we had our first glimpse of the mountains of Colorado. They rise majestically on the edge of Boulder, forming a most picturesque background for the campus. The buildings of the University are all of the same type of architecture and are laid out in the most systematic fashion, the various buildings of each college being grouped together.

The convention met in the Memorial building of the University immediately after our coming. Dean Evans of the Engineering School welcomed the delegates on behalf of the Colorado Engineer. The business of the first morning included the annual report of Mr. Merrihue, chairman of the E. C. M. A., and also one by Mr. Littell, the advertising representative. After a group photograph had been taken, there was an adjournment for luncheon.

Before meeting again that afternoon, a short inspection of the campus was made. The engineering buildings and the laboratories were visited, all of them being most modernly built and equipped. The trip ended at the Memorial building and the delegates again entered into conference. The rest of the day was occupied with the appointment of committees, criticism of magazines, and general advice to the member publications.

Thursday evening we were the guests of the Engineering School of the University at their annual "Apple Fest." At this yearly event the engineers gather together for an evening of fun and entertainment. Several wrestling and boxing bouts furnished the amusement, while refreshments in the form of apples, cider, and doughnuts were offered.

Friday the delegates again gathered in the Memorial building for their second and last day in convention. The morning was entirely taken over by the delegates in a round table discussion, in which the topics of editing, advertising, and circulation were talked over. In the afternoon the business of the convention occupied the time of the delegates. The chairmen were reelected for another term, the Tennessee Engineer was accepted as a member of the E. C. M. A., and other business items were settled.

After the meeting had adjourned, we were all taken in cars up into Boulder Canon for dinner. Speeches by the three chairmen of the convention and by the editor of the Colorado Engineer were the features of the program. Later in the evening the Colorado Engineer acted as host at a dance held in the Memorial building.

The next day was entirely devoted to sightseeing. All of us were bundled into cars and taken for a trip through the mountains, which, I for one, will never forget. We wound our way up Boulder Canon, arriving at the University Camp in time for lunch. Lunch, this time, consisted of a steak fry, and we ate steaks enough for a regiment. After eating, we again boarded the cars and drove high up into the mountains to Estes Park, where many wild deer were seen. We headed back for Boulder through Big Thompson Canon, arriving at the campus about six o'clock.

Most of the delegates left Boulder that night for Denver, from which point they departed for their own campuses.

The beauty of the campus at the University of Colorado may be seen by this view of the Chemistry Building.

The Prior Art

By E. W. Adams, '08

Assistant General Patent Attorney, Bell Telephone Laboratories

NO discussion of patents proceeds very far without some reference to the "prior art" and as the term is not defined in the usual dictionaries, some consideration of what it is, where it is to be found, and its effect on the patenting of inventions should be of interest to inventors and potential inventors.

Unfortunately, the term is not capable of short and accurate definition. Broadly speaking, the prior art is the sum total of human knowledge prior to the present moment. With reference to the patenting of inventions, it is limited to that portion of human knowledge which embraces what has been invented or constructed, or what has been made available to the public by use, patents, or printed publications. It has been designated by a recent commentator as "an indefinite multitude of inventions which were once new but have already become old."

This multitude of inventions, publications, patents, and things which have been constructed or used is widely distributed and is not readily accessible. To find the prior art with reference to a given invention it is necessary to have recourse to certain available sources of information, which may be divided into the patented art, the published art, and the common knowledge and usage of professions or trades.

The patented art is usually a part of the published art although not necessarily so, because patents of some countries are not published. There is no publication of patents in such important countries as Belgium and Italy, for example, and there was a period when there was no publication of patents in France. It is useful, however, to consider the patented art in a separate classification, because, quite apart from the publication of patents, the granting of a patent has by statute a very definite effect upon subsequent patents for inventions. A determination of whether an invention is in the patented art involves a search, but fortunately the patents in the major countries are classified.

In the United States, the patents are quite finely divided into classes in accordance with the subject matter claimed. In Great Britain, a comprehensive digest of the patents is published in classified form. The German Patent Office classifies according to subject matter each of its patents as issued; this classification, however, is somewhat different from that used in the United States. In France, the patents are classified along broader lines. In other countries, in general, some attempt is made at a classified index, but as most of the important inventions are patented in one of the major countries, a search through the classified files of these countries will give a very comprehensive knowledge of the patented art.

Edgar W. Adams

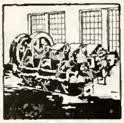
The published art includes the entire field of printed publications. The most fertile part of this field is to be found in the technical and trade journals and the proceedings of the various scientific societies. There are a number of indexes published and useful for this purpose which are familiar to most engineers. These indexes, of course, do not take the investigator to all of the published art but they are very useful in locating the more important publications. Such things as doctors' theses and publications of local societies can only be found by following some definite clue.

The common knowledge and usage of a profession or trade is reflected in the technical articles, but useful material along this line is also to be found in trade catalogs, bulletins, instructions accompanying apparatus sold, and in correspondence between members of the trade or profession. About the only way to run down this sort of information is to consult with men who have had experience in the particular profession or trade under investigation.

An apparatus, system, or process which has been made and used or sold is presumed to be a part of public knowledge and hence a part of the prior art, although actual knowledge of such manufacture and use or sale may not be nearly as widely distributed as a printed publication. In fact, a single use or sale establishes the existence of the device or process as of the date of such use or sale. In some countries, France for example, prior use or sale anywhere and at any time before the filing of an application for patent is within the prior art. In others, the use or sale must be within the country.

The effect of the prior art on the patent is always one of limitation. In general, the prior art may be considered as the environment of an invention and the extent to which an invention differs from that environment determines the scope, or, as it is often put, the place of the invention in the art.

(Continued on page 30)



ENGINEERING NEWS

Leavened Concrete

Research has produced a building material of concrete which is composed of countless minute cells produced by a chemical process akin to the action of yeast in bread dough.

Aerocrete, as this new material is known, was originally developed by a Swedish scientist, who was able to make a serviceable substance, although it would not withstand great weight. Two years ago aerocrete was introduced in the United States and, since its introduction, it has been improved so that it now meets the most exacting fire and water-load tests required of flooring materials.

Its components are cement, sand, and small quantities of lime, aluminum powder, and soda. The aluminum powder in an alkaline solution causes a chemical reaction when this mixture is poured in a thick liquid form, and the hydrogen liberated is the leaven that forms the cellular structure. The control of the ingredients makes it possible to vary the expansion from 50 to 150 per cent of the original volume.

Recent tests of the new material showed that a floor of aerocrete 4½ inches thick kept a temperature of 139 to 207 degrees F. on its upper surface during the last hour of a four hour test, in which a fire was kept burning beneath it at a temperature of 1825 degrees. In a fireproof building the temperature of a fire will rarely exceed 1700 degrees.

The advantages claimed for aerocrete as a structural floor are its lightness (its weight is 20 to 75 per cent that of concrete), high heat-insulating value, and sound-deadening properties. It is estimated that it will reduce by one-fourth the weight of steel required to support a building, a reduction comparable to that afforded by welding.

Hydrogen-Cooled Synchronous Condenser

A hydrogen cooled synchronous converter has been recently manufactured and shipped for installation in the automatic regulation of the voltage on transmission circuits. This particular machine is rated 15000 k.v.a., 11,500 volts, three-phase, 50 cycle, 750 R.P.M., and will be filled with hydrogen gas for cooling instead of air.

A view showing one of the new types of hydrogen-cooled condensers being shipped ready for use.

Many advantages have been gained by the use of hydrogen instead of air. The output of the machine is increased about 25 to 30 per cent. The power consumed in losses is reduced, this reduction showing up very distinctly at the fractional loads. The damage to insulation arising from static discharge is practically eliminated. Fire hazards are reduced to a minimum, since hydrogen does not support combustion. The machine will always be clean, inasmuch as it must necessarily have a closed system of ventilation which eliminates dirt.

The condenser will be operated out-of doors and requires no structure to house it. The hydrogen is water-cooled, the coolers being located within the machine. The collector rings and brushes are in a small chamber at one end of the machine and these may be inspected through small glass windows while the machine is in operation.

Smothering Power Roar

Considering that 100 horsepower automobile engines are commonplace today, readers will be surprised to discover that during the past few months engineers have been busy solving a problem involving a mere ten-millionth of a horsepower. It is a problem caused by air pressure variations of less than one five hundredth of a pound.

This problem is a question of eliminating open throttle power roar, a noise resulting from air pulsations in the intake manifold caused principally by the opening of the intake valves. Such noise is actually "air hammer" which is comparable to water hammer. Lucky it is that the power roar is such a small fraction of what the engine develops. If one horsepower could be completely converted into noise, it could be compared to the din and roar that 750,000 wildly cheering people would make.

The solution has been along two somewhat different lines with the same principal as a basis. A sound wave consists of crests and troughs or pressure variations. For the elimination of a sound these crests and troughs must be canceled or smoothed out. Our first thought would be the use of a muffller with conventional baffles, through which the gases are forced. However, this mixes up the crests and troughs, so as to result in a partial elimination. Our object is to obtain, if possible, a complete silencer.

The first development along this line yielded the intake silencer. It consists of two perforated tubes surrounded by sound absorbent material. Pressure waves having alternate pressures of 15.001 to 14.999 pounds ripple back through the intake manifold and carburetor and enter the silencer tubes. As a high pressure crest moves through these tubes, its excess pressure is gradually absorbed in the multitude of air passages in the absorbent material. Likewise, as the following low pressure trough moves through the tubes, the air enmeshed by the absorbent material flows out through the perforations to bring the pressure of the trough up toward normal. In this simple fashion the crest is robbed of its excess pressure, and this excess is returned to the trough. Such a device depends entirely upon the absorbing quality of the material used.

The second development along this line depends on the length of the waves, that is, the distance from one high pressure crest to the next. In this type of silencer, a main chamber is purposely proportioned, so that the high-pressure crest of the wave reflected from the far end of the chamber, returns to the intake passage just as the ensuing low pressure trough arrives. The sound issuing from such a device is practically inaudible. It is readily seen that such a device holds for this speed only, but for no other speed. Therefore a design for variation must be found. This has resulted in the addition of one or more chambers, depending on the rated engine horsepower, and a very complicated sound wave action.

From this can be seen the detail into which an engineer must delve after he once has developed the main idea. Energies ranging from a million horsepower down to the minutest fraction of a horsepower will be developed to an exactness in time.

Refinery Has Huge Gas Burner

One of the largest gas burners in the world has been recently installed in a sugar refinery at Johnstown, Colorado. The burner measures fourteen feet in length, has a nozzle opening 15 inches in diameter, and consumes 50,000 cubic feet of gas an hour.

Rubber Crystals Produced

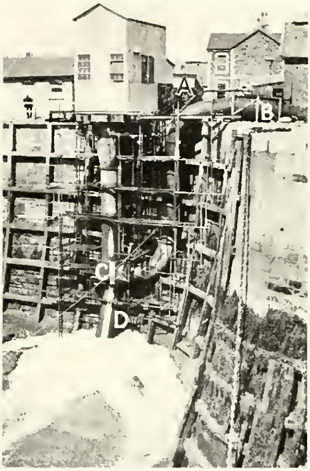
The true molecular formula for rubber, thus far uncertain, may be determined in the near future. Crystals of rubber have been produced in the chemical laboratories of the federal bureau of standards and are expected to aid chemists in finding the chemical composition of rubber.

The minute rubber crystals were produced when a pure block of rubber, transparent and colorless, was dissolved in ether and cooled at –80°C.

Tidal Power

Power from ocean waves and tidal flow has long been the desire of many an inventor. Many contrivances have been proposed or tried for the utilization of wave power. The reciprocating motion of floats that rise and fall with the tide have been directly connected to pump water. Wave motion has beeen translated into a hydraulic-ram effect for pumping water into a reservoir for waterwheel operation. Still another method has been the compressing of air by the rise and fall of the ocean.

Tidal power is a world old idea of filling a reservoir at high tide, so it may be used to run a waterwheel at low tide. Enormous heads may be obtained from the tides, but they vary from a maximum to zero. The engineer's problem has been, and remains, the means of supplying continuous power economically from an intermittent source.



A view showing the layout of a typical tidal power plant.

To this end a recent experiment has been carried to a fair scale. It is a 300 horsepower combination hydro and thermal plant for the development of power from the tides. In this model each unit consists of a waterwheel coupled to an electric generator. There is a water brake on the turbine shaft, which is connected to a thermal storage vessel and the water is circulated between them. When the water power available exceeds the electric power demand, the surplus is absorbed by the brake and stored in the water in the form of heat. The brake operates with the turbine governor in such a manner that as the load on the generator decreases or the head on the turbine increases, the quantity of water admitted to the brake is increased. This increases the braking load and automatically controls the speed of the water turbine.

The most important idea in this system is its regulation of water flow to the brake, so the temperature of the water will be raised to 390° F. This water is under a pressure at this temperature so as to remain a fluid, and is withdrawn as such and stored as hot water in the accumulator.

When the demand for electricity exceeds the direct supply, the reserve energy in the accumulator must be used. The pressure is reduced in the accumulator thereby converting the water to steam, which in turn operates a steam turbine.

The whole scheme seems rather fantastic, but looking the project squarely in the eye, is it? The only element in this project that has not already been adopted in standard practice is the use of the brake for producing high-temperature water, under the corresponding pressure. Is this one feature going to upset our whole plan? No! Development work is being pushed along this line at present, and many other experiments on a larger scale are being proposed.

Electric Ring Causes Magnetic Storm

According to two English physicists, magnetic storms are caused by a ring of electric current which surrounds the earth. They believe this current occurs in a stream of neutral ionized particles shot out by the sun. It has long been the belief that magnetic storms frequently are associated with sunspots. As the stream advances toward the earth, the magnetism of that body sets up electric currents in its path, producing magnetic effects that produce the main phenomena of a storm.

Aluminum Alloy Crane

The structural engineer has entered the research field in the past few years with the object of obtaining a lighter material for construction purposes. He has found success along this line to a certain extent, but up until this time nothing of very large size has been attempted. But a ten ton shop crane has recently been completed with this object in view. With the exception of the framework for light-

(Continued on page 32)

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

Vol. XXII November, 1930 Number 1

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> *The thing today is to be practical. What you want is to get education, and with it you want good character, and with these you want unfaltering industry, and if you have these things you will have success anywhere and everywhere.*
>
> —*William McKinley.*

THEORY RECENTLY advanced by some of the leading scientists of the world seems to indicate that there is a wealth of energy stored up in nature which, if we devise the necessary means of harnessing it, will give the world an almost unending source of power.

To the unthinking individual, our natural resources, such as coal, gas, oil, and their products, may seem to be unlimited in their supply. But, on the contrary, they are limited. With our modern pace of living, and the vast amount of energy used to run our machinery and furnish the power, heat, and light we need, these resources will become exhausted in a comparatively short time. There are, however, many other ways in which nature has blessed us with energy and we have not yet found methods of utilizing it. It is the problem of the engineers to develop means of utilizing this power, which otherwise is lost to the use of mankind.

Among the possible sources of additional energy are the ocean currents, the temperature differences in the ocean, the tide, and static electricity of the air. All of these sources of power, and many others, are at hand and merely waiting for the master mind to conquer them. Some of nature's sources of energy have already been harnessed. Among them are water power of streams, and wind power. The high degree of efficiency obtained from these sources should be an incentive for the scientists and engineers to strive to conquer the large amount of unharnessed energy.

All engineering students have aspirations to do great things in their profession, and to give something to the world by which they will be remembered. In this particular field the opportunity is golden, as the surface has hardly been scratched in the knowledge of harnessing natural energy. Although the sources of power which we use now may some day become exhausted, as long as the sun keeps shining and this old world of ours keeps turning, there will be a wealth of energy to utilize when we have conquered it.

ON THAT MEMORABLE DAY of December 17, 1903, when Orville Wright and his brother completed the first successful flight, it was never dreamed that in only twenty-seven years the air, the world over, would be filled with speeding airplanes carrying, at almost unbelievable speeds, every form of cargo. To the Wrights must be conceded the lion's share of the credit for their initiative and dogged determination but to science and engineering interests must go the credit for the vast and rapid development of their ideas.

Possibly the latest and greatest exhibit of modern developments in aircraft speed and reliability was the recent National Air Races held in Chicago in August of this year. Here were assembled the speediest, safest, and best designed planes in the world to-day, along with probably the greatest array of aeronautical engineers ever gathered to-gether in one group. There were gathered there flying representatives of the government, many members of large aviation corporations, and even a greater number of individuals from this country and others, all drawn to-gether for one and the same purpose, namely, to exhibit their handicraft, their reliability, their engineering development, and, above all, their speed.

From the time of the experimental stage to the present day, advance in aviation has been incredibly swift. The aircraft as we see them to-day mark a new high point in the achievements of designers, engineers, and pilots, which one by one aided in the triumph of man's conquest of the air. Inasmuch as this annual air show has been termed the "Air Races" many of our more reserved and skeptical citizenry may ask the reasons for all this exhibit of speed, this great expenditure of money, effort, and time, this continual striving to make it possible for man and mass to cheat the element of time. These questions might be answered in innumerable ways. Is it not the human desire to get ahead, to make time, so to speak? Has not already the speed of aircraft brought nations closer to-gether, created good will, and aided man in the everyday transaction of business? In defense, therefore, of this constant and continual strife between man and time we ask if these things alone do not constitute sufficient reason for the existence of that strife. However, it must be remembered that it is not only a great engineering feat to create a new speed, but it is of much greater importance that that speed be made adaptable to man's use. It must be remembered, also, that travel at the new speed must be made reasonably reliable. The fact must not be overlooked that although this annual air event is called "Races" it is a superb demonstration of reliability of man-made engines and devices as well as a display of speed.

Thus as 1930 makes way for a new year we anxiously await the National Air Races of 1931, and the survey of the new accomplishments of engineers and pilots which are now being worked out in every nation of the world.

DURING THE Engineering College Magazines Associated Convention at Boulder, Colorado, awards were presented to the publications that had earned them by the excellence of their issues of last year. The Armour Engineer succeeded in distinguishing itself by acquiring several of these coveted prizes. They were as follows:

First place for the best editorials.

Second place for the best student articles.

Third place for the best single editorial.

First honorable mention for the best covers.

Second honorable mention for the best illustrated issues.

Second honorable mention for the best alumni section.

To the members of the staff of last year must go the honor for the highly creditable showing made by the Armour Engineer. By their work they produced a publication of which the school may be justly proud. Evidence of the excellence of their product is shown by the number of awards received. The members of the staff for this year wish to congratulate those who were responsible for the fine issues of last year, and hope that they will be able to attain the same high standard.

THE ENGINEER,—AN ECONOMIST. Fifty years ago Arthur M. Wellington made that now classic remark, "Engineering is the art of doing well for one dollar what any bungler can do for two dollars." As we look about us today we see the truth of that statement everywhere. Let us take any branch of engineering and note how the engineer has effected great economic savings for all.

In the field of electricity, perhaps, have the most outstanding feats been accomplished. The engineer by research and experimentation has so controlled the electrons in their flight that they now are wholly obedient to man and furnish him light, heat, and power easily and cheaply.

FLOW GENTLY, SWEET AFTON

Flow gently, sweet Afton, among thy green braes,
Flow gently, I'll sing thee a song in thy praise;
My Mary's asleep by the murmuring stream,
Flow gently, sweet Afton, disturb not her dream.

Thou stock-dove whose echo resounds through the glen,
Ye wild whistling blackbirds in yon thorny den,
Thou green-crested lapwing, thy screaming forbear,
I charge you disturb not my slumbering fair.

How lofty, sweet Afton, thy neighboring hills,
Far mark'd with the courses of clear winding rills;
There daily I wander as noon rises high,
My flocks and my Mary's sweet cot in my eye.

How pleasant thy banks and green valleys below,
Where wild in the woodlands the primroses blow;
There oft, as mild Evening weeps over the lea,
The sweet-scented birk shades my Mary and me.

Thy crystal stream, Afton, how lovely it glides,
And winds by the cot where my Mary resides;
How wanton thy waters her snowy feet lave,
As, gathering sweet flow'rets, she stems thy clear wave!

Flow gently, sweet Afton, among thy green braes,
My Mary's asleep by thy murmuring stream,
Flow gently, sweet Afton, disturb not her dream.

—Robert Burns

The civil engineers have also contributed their bit to mankind but in a somewhat different manner. The credit for the increase in speed of transportation by rail over sound roadbeds and strong bridges, by bus and automobile over smooth concrete highways, and by air in safe and comfortable planes, may all be given to these men. The savings of money and time by them have been so great as to be beyond calculation.

The development of machinery to such a degree that man may profit to the greatest extent has been due to the work of the mechanical engineer. The production of manufactured articles has reached a new degree of speed and efficiency. The hands that once did the actual work now control the machines that do it for them. Much energy once spent in labor is now devoted to sport and recreation.

To the work of the chemical engineers man owes much. By constant research and experimentation they have made our everyday life safer, cleaner, and healthier; they have aided industry by shortening the length of time of necessary chemical reactions; they have increased the percentage of usable products in manufacture to a maximum.

The fire protection engineers have also been active in their field of endeavor. By protecting homes and industries against fire, they have reduced losses almost to a minimum. The leveling of residences and factories by fire deprives man of work, comfort, and protection. Thanks to the fire protection engineers, such disasters are becoming more and more of a rarity.

Such items as noted above are of course only a small part of the work accomplished in the respective divisions of engineering. But they are sufficient to convince anyone of the large part the engineer plays in the economy and comfort of our existence. The rewards from his endeavors may not be noticeable at first, but in the end they shall be there. Truly, the engineer is an economist of whom the world should be proud.

IT HAS FINALLY become a well established fact that indulgence in extra-curricular activities is not fatal to scholarship. Statistics prove that generally those who are most actively engaged in work that is not included in the curriculum are also those who rank highest in scholarship. The reason for this condition is not difficult to find, for the student who has the talent to rank high in scholarship will have the ability to engage in other intelligent work.

An individual's career in college should prepare him for active and successful competition in the practical world. While the work that he has done in scholastic courses has a large effect on his later attainments, it does not supply as much of that competitive quality that is desired. Extra-curricular activity and the effort required to gain success in it are the finest ways of acquiring such training while in college.

The seasoning effects of the greater responsibility, which is placed upon the shoulders of those who step beyond scholastic requirements, are found to be of immense value in life. At the same time new channels of thought enrich the older streams of reason, as numerous fresh experiences stimulate the mind. Initiative, resourcefulness, and the ability to co-operate with others, all develop best under the favorable influence of voluntary participation.

Well planned extra-curricular activities that supplement the scholastic work, effect a valuable addition to a college career. There should be harmony between both phases of this ideal education, so that the best in a student may be developed, and discrimination in favor of one against the other should be discouraged.

COLLEGE NOTES

W. S. E.

At the first meeting of the year, October 21, Mr. C. I. Morse, former chief engineer of the Rock Island railway, gave a talk to the students of the civil department. Mr. Morse related many of his interesting experiences as a railroad engineer.

"To become successful as an engineer," said Mr. Morse, "a man must place engineering achievement ahead of money. He should have character, judgment, industry, persistancy of effort, education, and executive ability. A man's success in life is something which is up to himself. Every man, at some time or other, receives an opportunity and it is up to him to make the most of it."

Although Mr. Morse was engaged for the first fifteen years of his career on railroad location, he said that he never worked a day in his life, having considered his job as play.

The W. S. E. looks forward to another successful semester, and requests members to attend meetings when possible.

F. P. E. S.

This year, the officers of the Fire Protection Engineering Society are:

A. F. Wilde	President
A. H. Jens	Vice-President
W. M. Miran	Secretary
M. C. Larkin	Treasurer

The society has had two speakers so far this semester, J. H. Foster of the Illinois Audit Bureau and R. Plant, chief engineer of the Fire Prevention Bureau.

Mr. Plant spoke October 24th in Science Hall, about sixty-five students being present. He discussed building construction from the viewpoint of fire prevention, and emphasized the danger of long vertical shafts as a means of carrying fire from one floor to another. He also told several interesting stories about some of the more important fires that have occurred in Chicago.

A. I. Ch. E.

Officers of the A. I. Ch. E. for this semester have been elected as follows:

President	Fred Attwood
Vice President	Gervase Stockmann
Treasurer	Harold Latham
Secretary	Orville Linnell

The meeting day of the society is the second Tuesday of each month. The first speaker for the group this semester was Dr. Bartow of the State University of Iowa. His subject was the American Institute of Chemical Engineers. Dr. Bartow also told about the World Engineering Congress in the Orient.

Plans are now being made for one of the society's big events of the year, the annual A. I. Ch. E. smoker.

OUR VARSITY CAPTAINS

Basketball

Clarence J. Robin

Clarence J. Robin, a junior in the department of civil engineering, takes the leading hand on the Armour basketball team this year. Hard work on the varsity squad for the past two years has advanced him to this position. His basket scoring placed him second in rank among the cagemen of last year. With his ability, it is only natural that he will encourage the team on to victories against some of the strongest teams of the middle west this year.

Clarence J. Robin

Robin has been a Chicagoan all his life, first seeing the light of day in this city on April 6, 1909. After his graduation from grammar school, he attended the Lane Technical High School. His athletic activities at Lane were basketball and baseball. In the latter sport he achieved notable distinction, being a member of the 1926 and 1927 city baseball champions. In 1927 Robin was selected as first baseman for the mythical all-city prep team.

His abilities at Lane were not limited entirely to athletics, however, as Robin was awarded the Armour scholarship for his high school. He entered Armour in 1927, architecture being his chosen course. He changed next year, however, to civil engineering, in which course he will graduate. In the past three years, Robin has earned five letters and has been elected to the captaincies of both the basketball and baseball teams. He is also president of the Armour Tech Athletic Association, a member of the Athletic Board of Control, president of the Honor A Society, and president of the Inter-Fraternity Council.

Robin is affiliated with the Phi Pi Phi fraternity and also the Chi Epsilon and Tau Beta Pi honorary fraternities.

A. S. M. E.

At the first meeting this year, Professor Gebhardt explained the purpose of the A. S. M. E., and created enthusiasm among the members. Professor Roesch demonstrated his sound intensity measurement machine, and discussed its various applications, particularly that concerned with detonation.

A very interesting talk was given at the second meeting by Mr. E. D. Oelerking, official Chicago Daily News inspection guide. He discussed some of the major problems encountered in erecting the Daily News Building over railroad tracks, and explained many interesting phases of newspaper work.

For the future Friday bi-weekly meetings, a variety of semi-technical programs are being arranged. Speakers on such subjects as marine engineering, Diesel engines, airplanes, dirigibles, astronomy, power generating equipment, subway construction, Egyptology and ancient engineering, dredging and building construction, fabrication of steel shapes, and others, are being sought. Freshman and sophomore mechanicals will be invited to enjoy several of these programs as well as one of the three or four smokers to be given.

Joint engineering society banquets are given at other institutions and the A. S. M. E. will endeavor to sponsor one at Armour.

A. I. E. E.

The Armour branch of the A. I. E. E. elected as its officers for this year:

Chairman	K. Knittel
Vice Chairman	C. Van Osdol
Secretary	E. Squires
Treasurer	R. Kellner

Recently, a talk was given by the chief electrical engineer of the Sanitary District to the members of the A. I. E. E. He discussed the work of the sanitary district and explained the function of the electrical division.

Chi Epsilon

Chi Epsilon, honorary civil engineering fraternity, has as its officers this year, the following men:

E. Johnson	President
B. S. Lindquist	Vice-President
B. G. McLaughlin	Secretary
K. E. W. Hellsen	Treasurer

The fraternity is to have a formal initiation in December. A banquet and theatre party will follow the initiation.

Freshmen Win Interclass Basketball and Baseball Championships

The juniors defeated the seniors, 14-11, in the first game of the interclass basketball series this fall as the seniors failed again to break the spell that seems to prevent them from winning championships. The seniors played well in the first half, stopping the juniors 7 to 4. They played even better basketball in the second half, but the juniors demonstrated their version of the sport and played like demons to win the game, 14 to 11.

The freshman-sophomore game was a thriller. Although the freshmen displayed great skill, the sophs became desperate and managed to tie the score, 13 to 13, at the end of the last quarter. However, thirteen seemed to have been the soph's unlucky number and the freshmen won in an overtime period, 17 to 13.

There was no doubt from the beginning to the end of the junior-freshman game what the outcome would be. The freshmen played a superior brand of ball and won easily 24 to 10.

With Charlie Mago in the box, the seniors experienced little difficulty in winning the first interclass baseball game from the juniors by a score of 9 to 1. The freshmen followed suit and defeated the sophomores 9 to 1. However, the climax and complete upset came in the senior-freshman game. Both teams enjoyed good pitching but the freshmen managed to slip in a few more good plays to win the game 1 to 0.

Freshmen Handshake Held on October 1st

On Wednesday evening, October 1st, the first social affair of the year was held. The occasion of this was the annual Freshmen Handshake, held as usual, in the Mission. This event brought the upper classmen and the freshmen in contact for the first time, and the opportunity was offered for all to get acquainted.

A program that was both entertaining and instructive was furnished in the Assembly Hall in the early part of the evening. Professor Raymond gave a short talk in which he emphasized the need of establishing friendships in college; Professor Leigh told of the necessity of engaging in the activities about school in order to break up the grind of study; Professor Amsbary gave readings of several selections from his own writings; and the Stresses and Strains offered their well known brand of good jazz music.

After the entertainment was concluded everybody headed for the refreshments which consisted of the traditional cider and doughnuts. Over the cups of cider, therefore, were many friendships formed which will last forever.

Boxing Team Promises Successful Year

The boxing team, this year, had one of the largest turnouts in its history as a sport at Armour, about twenty men appearing for practice. The veteran fighters of last year who are back once more are: Montesano, a small fast man; Larkin, who was not active on the team last year, but who is one of the best; Donnelly, a game scrapper; and last but not least, Captain Ustryski. When Ustryski first came up to practice last year, he came up as most of the fellows do, just to learn something of the manly art of self-defense, so that in case he ever got into any trouble, he would be able to handle his "dukes" properly. During the season, he was in several meets, and did very well. He ended up the term with a reputation as a slugger, and was elected captain after only one year of actual competition.

Some of the new men that came out for the team this year are Graham, Young, Rush, Hauser, Campione, Palmer, and Davidson. The ability of these men in actual bouts is, of course, still a question. However, they are all game and willing to learn. As has been mentioned before, most of these fellows come up to learn what they can about fighting with their fists. They do not come out for the team for the glory of it. Most of the new fellows have never had any experience in boxing and are green. However, the team is backed up by last year's men, which adds very much to their chances of success.

Captain Ustryski stated that special efforts are being made to book more meets for the season. Last year there were five and this year an attempt is being made to card six. It is expected that there will be at least one meet before Christmas in the Armour gym.

The more important meets, however, will come after New Year's, including bouts at Bloomington, Illinois and Culver Military Academy, Indiana. An attempt will be made to book a bout with St. John's Military Academy.

Coach Weissman, who made his debut as coach last year, deserves a great deal of praise for the achievements of the team.

BOXING TEAM 1930-31

Reading Left to Right, Back Row: Coach Weissman, Rush, Melevsky, Minnick, White, Captain Ustryski, Nelson, Gross, Cannon. Front Row: Campione, Koko, Sandstrom, Montesano, Heckmiller, Winegar, Hauser.

Varsity Basketball Team Starts Practice

The first basketball turnout was on the third day of November, and the group of approximately forty men crowded themselves upon the floor of our small gym. Among the old faces, we found five letter men of last year's team, namely: Captain Robin, Rossing, Rutkowski, Miran, and Ott. The other familiar faces were Lind, O'Connor, Sandstedt and Pepe, all of whom also took an active part in the cage work last season. The new hands out for the team, that is to say, the freshmen, showed considerable activeness and ability, and seemed to be very promising.

Practise on our own floor continued until the seventeenth of this month, at which time the squad moved to the Armory at Thirty-Fifth and Giles, where the necessary space was provided for. The squad consisted of the choice players picked by Coach Krafft during the practises on the Armour floor. At the Armory the tedious grind will continue until the first of March.

Last year's team opened the season in good fashion by winning five of the first seven games played. From then on, it suddenly took a slump, which was mainly due to injuries and sickness, resulting in a number of losses. With the ever present jinx hovering over them, and with little or no outside support, the team managed to carry on its work as well as could be expected for the rest of the season.

The first game to be played this year will be against the Alumni. It will probably be scheduled on a date in the earlier part of next month. Being the opening game of the season, the Honor A society will hold a banquet after the game, as has been the custom for previous years.

In reference to the other games, we find that the Tech squad will swing into a very hard schedule. Some of the teams are known to be the strongest of their class in the middle west. Among these we find Crane with its some two score of continuous wins during the last two years. From the little nineteen conference, we have Augustana and De Kalb, both teams ranking among the first four of their class. Then there is St. Mary's with its ever snappy, hard fighting squad. Western State of Kalamazoo, Michigan may also appear on the schedule. The full line-up of teams has not been definitely arranged as yet, but one may be sure that a tough schedule will be made up.

Armistice Day Assembly

On Tuesday, November 12th, a general assembly was held to celebrate Armistice Day. General Foreman gave the address.

Tau Beta Pi

The officers of Tau Beta Pi, honorary engineering fraternity, are:

F. B. Attwood........................President
C. T. Link........................Vice-President
A. F. Wilde..........Recording Secretary
A. B. Auerbach....................Cataloguer

Seven seniors and three juniors received the brown and white pledge button during the pledging ceremony on October 29. The seniors are: Fetterman, Hellsen, James, Lenke, Seidelman, Stevenson, and Strassenburg. The juniors are: Cavanaugh, Lind, and Robin.

Flask and Beaker

The following men have been elected to office for the coming year.

President ....Fred Attwood
Vice President........Gervase Stockmann
Treasurer..........................I. B. Lehman
Secretary ....Jack Cavanaugh

Franklin D. Paine was the recipient of the organization's award for the student having the highest average in the freshman chemical class. This award is one year's membership in the American Chemical Society. Jack Cavanaugh, now a junior, was the first one to receive this gift.

Pi Nu Epsilon

The members of Pi Nu Epsilon, honorary musical fraternity at Armour, plan to make this a big year musically, and expect to announce soon the new candidates who have been selected for membership in the fraternity.

The aim of the fraternity is to encourage a better appreciation of music among the students and to aid the various musical organizations at the Institute. The Orchestra, Glee Club, and Stress and Strains, are already getting programs ready for presentation at assemblies and concerts of which there are two, the Christmas concert and the Spring concert.

Members of Pi Nu Epsilon now in school are W. A. Schrader, R. R. Eddy, F. O'Conor, R. N. Wilson, and L. A. Newman. The officers for this year are, Eddy, president, and Schraeder, secretary.

Armour Radio Association

At the first meeting of the A. R. A., on October 24th, the following men were elected to office:

P. L. Van Osdol......................President
W. A. Schrader..................Vice-President
M. Fagen................ Secretary-Treasurer
E. G. Squires..................Chief Operator

It was announced at the meeting by M. Fagen that the radio station, 9XV, which is under supervision of the A. R. A., will soon be in operating shape, and may be used by members of the organization only.

Those who already are licensed radio amateurs, and those who are interested in radio, are invited to join the Armour Radio Association. Club members will assist every one who wish to become operators.

Professor Wilcox, faculty advisor, spoke about the origin of the association. He said that when the Wieboldt Stores donated a broadcasting unit to Armour, it was necessary to have an operating staff. The organization of a radio club solved the problem.

Scarab

On Monday evening, October 13th, Scarab, the honorary Architectural fraternity, pledged four men. They were M. H. Braum, E. J. Minx, C. M. Schock, and R. A. Peterson. Initiation ceremonies will be held for these candidates within the next few weeks. The actives of the fraternity at the present time are: A. J. DeLong, A. L. Mell, and A. J. Wichser.

A luncheon for all the members of Scarab was given Thursday, November 12th, at Field's. A number of alumni of the fraternity were present.

THE ROAD NOT TAKEN

Two roads diverge in a yellow wood,
And sorry I could not travel both
And be one traveller, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;
Though as for that the passing there
Had worn them really about the same.

And both that morning equally lay
In leaves no step had trodden back.
Oh, I kept the first for another day!
Yet knowing how one way leads on to way,
I doubted if I should ever come back

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and
I took the one less travelled by,
And that has made all the difference.

—*Robert Frost*

Salamander

Salamander, honorary fire protection engineering fraternity, has recently pledged five men. Four of these are seniors, while the fifth is a junior. The fourth year men are H. S. Holt, P. H. Keselring, F. M. James, and F. W. Spaulding. The junior is W. M. Trauten.

The officers for the coming year are:

A. W. Wilde...........................President
A. J. Lenke......................Vice-President
F. S. Austin.............................Secretary
W. E. Schirmer.......................Treasurer

Pi Tau Sigma

Six men have been pledged by the honorary mechanical engineering fraternity this fall. They are: Harold L. Fox, Andrew S. Hartanov, Mitchell J. Lamka, and Fred T. Munch, seniors; Newton C. Cannon, and Harold R. Davis, juniors. The pledging marked the climax of an enjoyable smoker that was well attended by faculty members and alumni. The officers for this semester are:

President ....Charles Link
Vice President...............Robert Krause
Secretary ....Frank Strassenburg
Treasurer ....Richard Stevenson

A new chapter, Carnegie Iota, was officially installed at the recent national convention at Penn State College.

Sphinx

Sphinx, honorary literary fraternity, initiated eleven men at formal ceremonies held at the Interfraternity Club on May 13, 1930. The following men were given the key of Sphinx to replace the yellow and black pledge ribbons they had worn: F. B. Attwood, A. J. Lenke, A. H. Jens, A. B. Auerbach, J. H. Stranberg, C. T. Link, R. N. Wilson, O. R. Murphy, K. K. Knittle, R. A. Timmermans, A. F. Wilde.

An election of officers for the current year was held when the annual business meeting was conducted by President D. T. Smith late in May. The following were elected to office for the 1930-31 year:

A. H. Jens ....President
R. N. Wilson..........Secretary-Treasurer

At the present time Sphinx is attempting to revive the Press Club. An all publication smoker is to be held later in the year.

Eta Kappa Nu

The officers of the Eta Kappa Nu, honorary electrical engineering fraternity are as follows:

Wm. Drigot.............................President
R. Patzelt..........................Vice-President
H. S. Marando......Recording Secretary
Wm. Penfold, Corresponding Secretary
A. R. Draus.............................Treasurer
Chas. Blahna...........................*Bridge* Editor
E. S. Warner...................Pledge Master

Drigot and Patzelt were elected as official delegates of Delta chapter to the national convention at Iowa State College, Ames, Iowa, on November 14 and 15. Penfold and Blahna will accompany them.

A theatre party is planned for the early part of December.

Phi Lambda Upsilon

The officers of Phi Lambda Upsilon, honorary chemical engineering fraternity, are:

I. B. Lehman...........................President
M. Yzaguirre...................Vice-President
F. B. Attwood...........................Secretary
H. Z. Martin.............................Treasurer

For the coming year, the chapter has plans for a smoker and an alumni banquet.

F. D. Paine, freshman chemical, will be the recipient of the honorary fraternity's award for the highest freshman chemical. This award is a physics and chemistry handbook.

Enrollment

About a third of the total registration this fall were freshmen. A very large number of applicants were refused and some are attending evening school so that they may receive preference next February or September and obtain instruction in a few courses in the meantime.

The enrollment in the various departments was as follows:

	4	3	2	1	Sp	Tot
M.E.	21	40	41	61	1	164
E.E.	37	36	54	53	0	180
C.E.	28	31	38	49	0	146
Ch.E.	23	18	27	38	2	108
F.P.E.	28	22	28	21	0	99
Arch.	24	21	43	41	2	131
Total	161	168	229	265	5	828

The Armour Alumnus

Volume VI Number 1

Prof. Richardson Placed in Charge of Placement Bureau

Office to be Maintained in Main Building at School

Since Mr. J. Warren McCaffrey, '22, has resigned his position as the Executive Secretary of the Alumni Association, an important change has been manifested in the policy of conducting alumni placement. When the law profession extended attractive overtures to Mr. McCaffrey, he had among his other duties in the Armour Alumni Association, the task of assisting alumni in securing positions.

When the Executive Secretary's office was vacated, President Raymond conferred with the officers of the Alumni Association and suggested a plan whereby the Institute would establish a Placement Bureau for the alumni and undergraduates, no charge of course being made for the service. Early in July of this year all necessary details had been worked out and the Placement Bureau was established, its office being located here at school. Mr. Donald E. Richardson, '24, Assistant Professor of Electrical Measurements, was chosen as the man to direct the affairs of the department.

Up to this time, the results already accomplished have been gratifying, according to Professor Richardson. Even during the present depression, he has succeeded in obtaining audiences with employers for every man who has intimated his desire of obtaining work through the Bureau. Quite a number of alumni have been placed in positions of steady and satisfactory employment. Applications for part time jobs made by undergraduates have been met, however, not so readily. The number of openings for such work are limited, and it is doubtful whether all the students desiring it can be accommodated.

D. E. Richardson

Perhaps one of the greatest advantages of placing the Bureau under the supervision of the Institute has been realized since its work has begun. Many of the professors at school also have connections in the business world and they are often asked by their employers to assist in obtaining competent men. Invariably these opportunities have been put at the disposal of Mr. Richardson.

To aid in presenting the abilities of the applicant for a position, a form has been made up upon which the educational, professional, and personal record of the man is placed. These blanks can be obtained by any alumnus by getting in touch with Professor Richardson here at school.

Armour Professor Lectures For A.I.E.E. and W.S.E.

Professor Ernest Freeman, head of the Department of Electrical Engineering, is giving a series of lectures on Engineering Economics conducted by the Armour Institute of Technology under the auspices of the American Institute of Electrican Engineers and the Western Society of Engineers. The class convenes every Tuesday evening at 7:00 P. M. in Room 1200 of the Engineering Building at 205 W. Wacker Drive. Professor Freeman's lectures embody many of the business and financial problems frequently encountered by the engineer. Incidentally a small group of alumni are among the interested students.

Muehlberger Now Coroner's Chemist

Clarence W. Muehlberger, '20, was recently appointed to a very important position on Coroner Herman N. Bundesen's staff, as chief chemist. Before assuming his present duties in Cook County, Illinois, Dr. Muehlberger was assistant director of the crime detection laboratory of Northwestern University.

Muehlberger's work was considered highly satisfactory in toxicology analysis and consequently he received the unanimous recommendation of the coroner's advisory committee of physicians.

Regular Alumni Luncheons and Meetings to Be Held Soon

The alumni luncheons will start in November and from then on will be held on the first Wednesday of each month at the Engineers' Club at 12:15 P. M. A speaker will be provided for at each luncheon. The alumni will be notified by postal each month as to the date, time, place, and the speaker. It is requested that more alumni avail themselves of the opportunity of meeting old pals, making new acquaintances, and of hearing the speakers who so kindly agree to address them.

Last year the attendance was but fair, averaging about twenty alumni at each luncheon. The speakers were very entertaining and their talks covered a wide range of subjects.

It is suggested if any of the grads are the least bit timid about coming alone, they should call up their pals and "come on over."

The annual alumni meeting will be held Dec. 17th, 1930; please reserve the date. The meeting place will be announced later. This meeting will be in the form of a "smoker." The election of officers for the coming year will be held and reports of the treasurer and committees will be given.

The alumni will be entertained by music and moving pictures. There will be no speeches because this is the time for conversation. If anyone at the meeting is afflicted with the "speech germ" he will be promptly innoculated with tetanus. Everyone will enjoy himself at a good old fashioned smoker. Yes, and there will be plenty to eat, too.

Alumni to Meet Varsity Squad in Basketball Game

The annual Alumni-Varsity basketball game will take place in the near future. All the old grads who still retain the art of putting the ball through the well-known hoop are requested to get in shape for the coming event. The others who are not so fortunate as to possess the necessary basketball skill are likewise urged to be in trim, even though their activities may be confined to the cheering section only.

In past years the alumni have always succeeded in giving the undergraduates quite a battle, and this year should be no exception. The varsity squad, however, will be no set-up as they are reputed as having a fast-shooting outfit this season. The Alumni game will be the first on their schedule for this year, so it will be more or less of a test for them.

PERSONALS

An announcement of the marriage of Harvey O. Snediker has been received. Snediker, a graduate in the Department of Fire Protection Engineering, class of 1928, is progressing nicely in the Minneapolis office of the General Inspection Bureau.

M. L. Landreth, '25, is happily situated with the Western Electric Company of Hawthorne, Illinois. The official title of Mort's position is chief of the dial equipment planning division.

E. W. Menke, '14, is assistant Chicago Sales Manager for the Automatic Transportation Company in Chicago, Illinois.

Leon J. Steck, '30, holds a civil service position as a Junior Civil Engineer in the Interstate Commerce Commission.

George Rezac, '29, formerly with the Public Service Co., is now earning a livelihood as an engineer with the United States Gypsum Company.

Webster O. Crane, '23, is a member of the faculty of Sterling College, Sterling, Kansas. Crane is professor of Electrical Measurements.

The Coats and Burchard Co. of New York formerly was the recipient of the services of Allen Boyer Benedict, '04. However, Benedict recently shifted to the Eastern Haynes Corporation, Industrial Engineers, of the same city

H. J. Moore, ex-'10, is now with Inland Steel Company after having served 20 years with the American Steel Wire Company of Cleveland, Ohio.

Robert Brinton Harper, '05, formerly President of the Armour Alumni Association, is one of the Vice Presidents of the People's Gas, Light, and Coke Company of Chicago, Illinois.

William Manske, '30, recently left the field of engineering to try the teaching profession. "Bill" is now a full fledged member of the Bloom Township High School faculty at Chicago Heights, Illinois. He was chosen to instruct freshmen in mechanical drawing and manual training.

Frederich D. Payne, '28, has joined the legion of benedicts. Miss Mary Clark of Maywood, Illinois, was the lucky girl. It is understood that Payne is now working in the engineering department of the Indiana Inspection Bureau. The Paynes are now residing in Indianapolis, Indiana.

Word has been received that H. H. Stebbins,'30, is working for the Illinois Tool Co. of Chicago.

The New York Bell Telephone Laboratories have acquired the services of three more recent Armour graduates. F. C. Ong, '29, W. L. Filmer, '30, and C. G. Anderson are all working for that company.

Schommer Produces Actual Photo to Prove Fish Story

John Schommer, our man of many virtues and "fish" stories, has come through with some infallible evidence this time in the form of a snapshot of some real whoppers which Mrs. Schommer and he hooked while roughing it up in Northern Wisconsin. An inventory of the catch shows that the professor's wife reeled in a 15½ pound muskelonge and a 7½ pound wall-eyed pike.

Our illustrious President caused quite a ripple among Izaak Walton's proteges by hooking a 14 pound wall-eyed pike. This is the largest of its kind ever caught in the vicinity of Boulder Junction, which is in the heart of Wisconsin's game fishing country.

The above photograph leaves little doubt as to the ability of John Schommer as a fisherman. He and Mrs. Schommer are shown with a day's catch.

According to John, the fishing in Wisconsin was never better than it was this last season. He and Mrs. Schommer made the best of it while they were there, as may be gathered from the snap-shot picture above.

Prebensen Helps Build Power Plant on West Coast

Harold Prebensen, '26, has recently returned from the west coast, where he has been busy working on the construction of a power plant of about 7000 K.V.A. The scene of Preb's enterprise was in the state of Washington, but he managed in his eight months' stay out there to see the entire coast from Mexico to Alaska.

He reports that a short time ago he received a letter from Dean Monin. In it, our former dean wished to extend his best wishes to all the Alumni.

Word has just been received of the marriage of S. J. McLaren, Jr., '28, to Miss Anna Helen Moorhead, on November 1, at Cadiz, Ohio. McLaren is special agent for an insurance company in Iowa and has his headquarters there. Mr. McLaren and his bride will make their home in Des Moines.

PERSONALS

John W. Hurley, '30, will soon receive his pilot's license as a flyer in the Naval Air Service. He is now nearing the end of his training at the Naval Training Station at Pensacola, Florida.

E. P. Boynton, '30, is reported as being the head of the Patent office of the United Chemical Company, located in New York City.

Donald W. Smith, '30, announces he is associated with the Buick Automobile Company plant at Flint, Mich.

Dean Banta, '30, and Emil Blomme, '30, are connected with the Illinois Steel Company at Gary, Ind.

Albert H. Winkler, '30, is a member of the engineering staff of the Stromberg-Carlstrom Carburetor Co. at South Bend, Indiana.

J. Edward Ransel, '30, is with the Indiana Inspection Bureau and has his headquarters in Indianapolis.

Robert O. Bradley, ex-'23, is doing sales work for the Dupont Paint Company in Chicago.

Packer Brown, '29, is engaged in sales engineering work for the Wallace and Tiernan Co. His main office is in Chicago, but Packer does considerable travelling about the middle west.

Frank Davis, x-'28, is employed by the same firm as Brown, but is station in Indiana.

Several letters have been received from Vernon Sturm, '30. He is employed by the General Electric Co., being located at Schenectady, New York, and from all indications he is enjoying his work immensely. He reports that there are several other recent graduates with him, including James Fee, '30, C. R. Southwick, '30, and E. W. Hanke, '30.

Norman Buehling, '30, is engaged in work up in Wisconsin, being employed by the Milwaukee Electric Crane and Hoist Co. as a sales engineer.

Word was recently received from William Wignall, '20. Bill holds an executive position in the sales engineering department of the National Boiler Washing Co. of Chicago.

Carl H. Johnson, '30, is working for the Western Electric Co. at their Cicero plant.

A visitor in the form of C. J. Beal, '30, appears every so often. He is working in Rockford for the Illinois Inspection Bureau.

Efficiency engineering has attracted the services of J. M. Kernan, '29. He is working in such a capacity for a paper box company in Chicago.

F. H. Bigeolw, '30, is connected with the Commonwealth Edison Co. Central station work is the department in which he is employed.

Heller Is Killed by Airplane Crash Into Lake

Duane L. Heller, who habitually made friendly excursions to the Armour campus in his airplane, was killed in a freak aerial accident last summer. According to reports emanating from the scene of the tragedy, Heller and a co-pilot were cruising low over Lake Michigan near South Haven, when the plane suddenly struck water and sank immediately. It is thought that perhaps the ship was being flown under mechanical difficulties which naturally brought the pilots to a low altitude. It was rather foggy during the flight and it is possible that the aviators lost their sense of direction. The smash up occurred within hailing distance of the shore and both men were subsequently brought to land.

Don Heller was graduated from Armour in 1924 with a degree of Bachelor of Science in Mechanical Engineering. After a short time he pursued a more specialized course and was awarded his Mechanical Engineering degree in 1928. He served as a cadet flyer at March field, Los Angeles, California. When the Continental Airways was established, he joined their organization and at the time of the accident held a position of superintendent with that firm. Heller was inaugurating a new air route between Chicago and Mackinac Islands when fate overtook him.

Prof. Richardson Becomes Member of Sigma Xi

Professor Donald E. Richardson, '24, has been voted an associate membership in Sigma Xi fraternity. Richardson did graduate work at the University of Chicago and was selected by the chapter of that school. Sigma Xi is an honorary scientific organization of which many distinguished pioneers in science hold keys.

Plan Honor A Banquet to Follow Alumni-Varsity Basketball Game

The Honor A Society will again endeavor to sponsor the annual basketball banquet this fall. Many of the old timers, including Kuehn, Allbeck, Manz, Havlicek, Bready, May, Johnson, Hoefer, Schumacker, Kuffel, Downs, Simpson, and others, are expected to attend following their participation in the annual contest during the late afternoon. The Honor A Banquets have always been enjoyable affairs and there is every indication of a repeated success. If John Schommer can possibly be present, he can be relied upon to awaken the joyful spirit that has characterized Honor A Banquets in the past.

All active alumni basketeers who seek to test their mettle against the formidable varsity aggregation, and those who will form the cheering section, are especially urged to reserve December 10th as a very likely date for the Honor A Athletic Banquet.

Jacobson Becomes Member of Armour Faculty

Joel M. Jacobson, '29, is now a full fledged member of the Armour faculty. Jacobson is teaching surveying to the civil engineering students. Incidentally, when Jacobson was at school he was honor man of his class.

Before coming back to Armour he was associated with the Fairchild Airplane Company at Farmingdale, Long Island, New York.

The Grasshopper

Shuttle of the sunburnt grass,
Fifer in the dun cuirass,
Fifing shrilly in the morn,
Shrilly still at eve unworn;
Now to rear, now in the van,
Gayest of the elfin clan;
Though I watch their rustling flight,
I can never guess aright
Where their lodging-places are:
'Mid some daisy's golden star,
Or beneath a roofing leaf,
Or in fringes of a sheaf,
Tenated as soon as bound!
Loud thy reveille doth sound,
When the earth is laid asleep,
And her dreams are passing deep,
On mid-August afternoons;
And through all the harvest peace,—
Thy gainsaying doth not cease.
When the frost comes thou art dead:
We alone the stubble tread,
On blue, frozen morns, and note
No least murmur is afloat;
Wondrous still our fields are then,
Fifer of the elfin men.

—Edith M. Thomas.

R. C. Peacock Returns to Chicago for Short Stay

After spending two years in the wild tropics of Africa, Robert C. Peacock, ex-'27, has returned to Chicago for a short stay. Peacock is with the Firestone Rubber Company, and is Chief Engineer for them in laying out their rubber plantations. "Bob" has had many experiences in his work in Africa and besides the many interesting things he tells, he has several reels of motion pictures, depicting the scenery and people of South Africa.

Bob will leave this winter for South America where he will engineer more plantations for the Firestone Company.

He says that one gets very lonesome in such a place with only a very few white people and the natives with whom to associate. Consequently, Bob intends to take a wife with him on his next sojourn. His engagement to Miss Frances Molt of Chicago has been announced.

Don Williams, '29, has entered the field of sales engineering. At present he is traveling about the middle west, doing work for a pump making concern.

Letter Is Received From Fernandez in Paraguay

Fransisco Fernandez, E. E., '14, is an Electrical Engineer, with the Paraguay Central Railroad and makes his home in Asuncion, Paraguay, in South America.

Dean Penn received a letter from Fernandez last August in which he states that he is doing quite well in his profession and he attributes the greatest part of his success to the training he received at Armour. To quote from his letter, he says, "With the technical training given me by Armour, all difficult tasks have, most of the time, turned out in the end to be achievable. My recognition to this fact has always kept Armour in my mind just as vivid, through all these years past, as when I was going from one class room to another and kept my college spirit as tip-top as if I were still a Soph."

Lost?

It has been indeed unfortunate that the Executive Secretary has lost track of quite a few of the alumni. From time to time important announcements are sent through the mails and it is imperative that such communications be received by them. A list of those whose addresses are not known is given below. Anyone who knows of the location of the following please notify the Institute.

A. J. Allyn
L. J. Anderson
J. E. Barman
C. A. Blomquist
W. H. Bodnar
Robert Brandy
S. Brennwasser
R. E. Brumund
H. V. Burke
M. L. Corle
P. M. Clemens
L. S. Downey
R. G. Ehman
C. S. Frankel
M. G. Gross
P. C. Hall
Everett Hanson
R. A. Harschner
B. I. Hogan
H. I. Hulgren
G. J. Jennings, Jr.
E. W. Lillienfield
W. K. Lyon, Jr.
F. E. Marx
L. B. McEwing
C. L. Ott
L. P. Overend
W. R. Owen
C. E. Patterson
F. B. Peterson
Sidney Pinel
Herbert Rose
H. F. Schrieber
H. J. Smith
L. V. Somers
D. H. Stark
G. W. Strom
H. L. Trimble
Eugene Voita
H. S. Wolin
I. H. Walt
H. E. Wetzel
C. H. White
B. A. Young
M. E. Zaldokas
A. J. Zelenka

M. A. Tennyson, '30, is associated with the General Electric Co. For a time he was located in Schenectady, but recently he was shifted to Indiana.

Don Josephson, '29, shifted his scene of employment to Quincy, Massachusetts, where he is doing engineering work.

J. E. Wack, '29, H. A. Wahlstrand, '30, and S. Janiszewski, '30, are all employed by the Teletype Co. in Chicago.

Ralph Phelps, '29, is employed by the Michigan Inspection. For a time Ralph was working in Grand Rapids, but he is now stationed in Detroit.

Elmer Geiger, '29, has selected a position as assistant chief engineer in a power plant located at Greensburg, Indiana.

STEPPING INTO A MODERN WORLD

A GROUP ATTACK ON THE "X" OF INDUSTRY

Research, finding answers to the eternal x=?, keeps step in the Bell System with the new industrial viewpoint.

The joy in working out studies in development is shared by many. Results are reached by group effort. Striving together, the mature engineer and his younger assistants, each contributes to the final solution of the problem.

Men of the Bell Telephone Laboratories are sharing in useful, interesting research. They are getting valuable training in the modern strategy of organized attack.

And because that strategy assures them the aid of men and material resources, they are actually turning some of their vision into fact.

Divide and Conquer —the WESTERN ELECTRIC idea in manufacturing

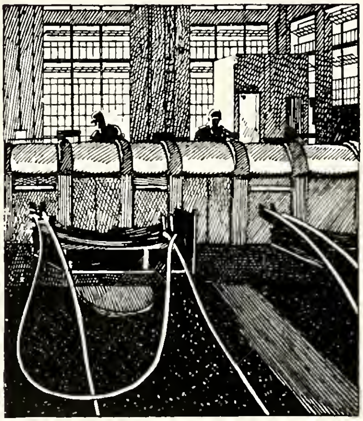
Organized effort is carried over also into the field of making telephones. First comes the careful division of a problem for thorough study by groups.

Telephone cable, for example, combines the suggestions of many men working in groups to improve various processes in manufacture.

One group found a better and quicker way to insulate the wires.

Another devised a unit type core which has made it possible to put 3636 insulated wires within a diameter of 2⅝ inches.

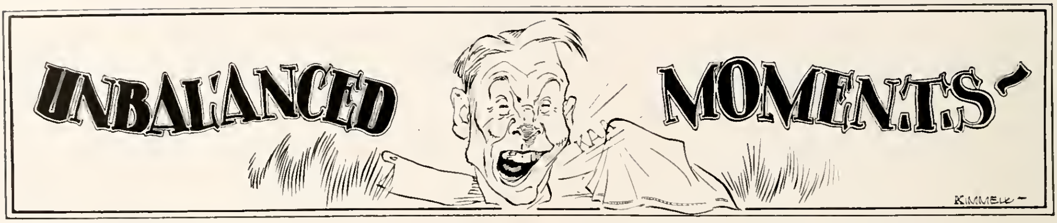
The surprising thing about this development method is that apparently minor divisions of the problem often assume major importance. *There* is the opportunity.



An opportunity is met. Western Electric engineers, seeking to improve methods of wire drawing, developed a rod and wire mill which is a model for industry.

BELL SYSTEM

A NATION-WIDE SYSTEM OF MORE THAN 20,000,000 INTER-CONNECTING TELEPHONES



WAY DOWN SOUTH

She (on date with bronzed athlete): "I just love big dark men."

He: "What a swell time you'd have in Africa."

A. H.: "Do you believe in clubs for women?"

C. J.: "Yes, if kindness fails."

"I hate that chap," quoth the lovable girl, as she rubbed cold cream on her lips.

Helen: "How do those football players get all the mud off?"

Ellen: "Silly; that's what the scrub team is for."

"Ugh," spluttered Mr. Jones. "That nut had a worm in it."

"Here," urged a friend, offering him a glass of water, "drink this and wash it down."

"Wash it down," growled Jones. "Why should I? Let him walk."

Casey: "Well I was elected."

Mother: "Honestly?"

Casey: "Well, what difference does that make."

Soph: "I don't deserve a zero on this paper."

Prof: "You don't, but I couldn't give you anything lower."

"Mother, is it proper to say you water a horse when he is thirsty?"

"Yes, darling."

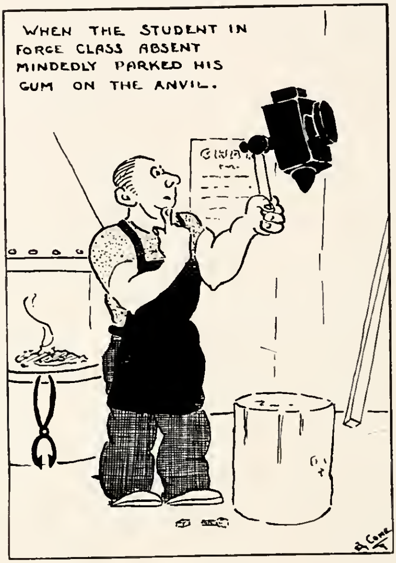
"Well, then," says our Jimmie picking up a saucer, "I'm going to milk the cat."

EFFICIENCY

"Now I've got that down Pat," said Mrs. Flaherty as she administered a dose of castor oil to her son.

One: "What do you think of my girl?"

To Another: "Very good. Very good. A fine Painting."


WHEN THE STUDENT IN FORCE CLASS ABSENT MINDEDLY PARKED HIS GUM ON THE ANVIL.

ANSWER TO A PRAYER

The woman wrung her hands and cried, "Oh give me bread." And her husband came home with a bun on.

He (disgustedly): "I think I've got a flat tire."

She: "Oh give me a chance. We're not a block away from home yet."

Teacher: "And why did Methuselah live to such a ripe old age."

Blond Child: "Oh probably just to spite some poor girl who married him for his money."

He: "She must have been a garbage man's daughter."

She: "Why?"

He: "She was always down in the dumps."

Newlywed (bragging): "Dinner only cost me one dollar for five persons."

Not so new: "That's nothing it only cost me thirty-five cents."

Newlywed: "What did you buy?"

Not so new: "Carfare to mother's."

T. D.: "I have a chance for the debating team."

D. P.: "When will they raffle it off?"

"What a whale of a difference a few scents make," cried the ad-writer as he tumbled over the skunk.

"Father, what's a pedestrian?"

"A pedestrian, my boy, is a college man's father."

HOOK AND SLICE

It isn't only a golfer's daughter who knows how to avoid all the hazards.

"Ha, Ha," said the young lady, as she slapped a louse on her back, "that's one on me."

Then we have the student who took to rolling more cigarettes when the doctor told him he needed more exercise.

There are certain streets in Chicago where it isn't safe for a woman to walk unescorted. Why just yesterday a woman had her face lifted on 31st street.

He: "Yes, I've changed schools."

She: "Oh. I'm so glad. I never did like engineers, for they always leave blueprints on my neck."

Baby: "Is Jens hot?"

Blue: "I'll say he is."

Baby: "How do you know?"

Blue: "Didn't you see the cinders on the track after his race?"

ALL FIXED

Husband: "My dear, these seeds you've ordered won't flower until the second summer."

Wife: "Oh, that's quite all right. This is last summer's catalog."

First Convict: "When does you-all leave heah, boy?"

Lifer: "De fust."

First Convict: "De fust of when?"

Lifer: "De fust chance ah gits."

"Will you love me forever?" pleaded the young suitor.

"I cannot tell that," coyly replied the sweet young flapper as she gazed at the beautiful necklace he had given her, "but I love you for the present."

Teacher: "Now, Jimmy, what is martyrdom?"

Jimmy: "I don't know what it is but I think it has something to do with marriage."

Beggar: "Will you give me Ten cents for a cup of coffee?"

Lind: "Let's see the coffee first."

BAD AND WORSE

A man rushed into a tobacco store.

"This cigar you sold me," he said, "is terrible."

"Well you needn't complain," said the tobaccoist. "You've only got one, I've got hundreds of them."

Stranger (at Triangle house): "I represent a society for the suppression of profanity. I want to take profanity out of your life and . . ."

Venema: "Hey, Lamping. Here's a guy who wants to buy your car."

Mr. Finklestein, walking into Mr. Goldberg's office: "Say, Chake, Vot's dot I smell?"

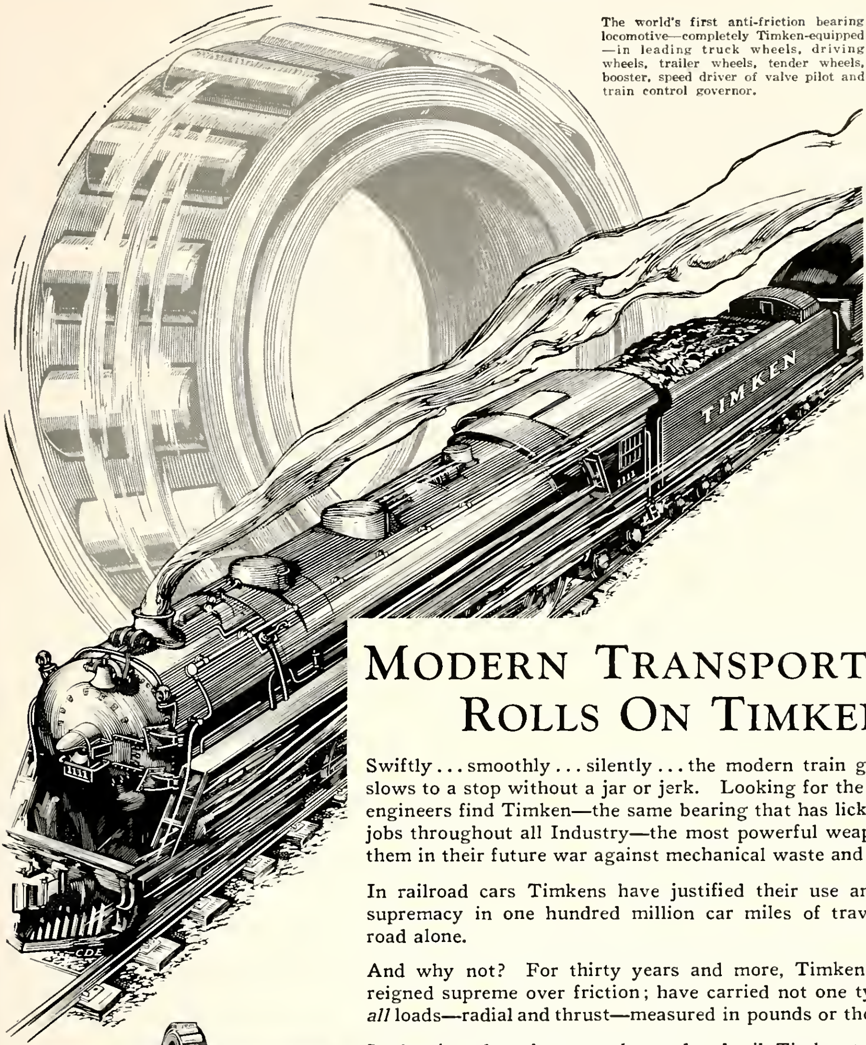
Mr. Goldberg: "Oh, dot's business. It's rotten."

Aspiring Trackman: "Are pancakes healthy?"

Stagg: "I never heard of one being sick."

John: "Does that dog chase cows?"

Henry: "No, he's a bull dog."



The world's first anti-friction bearing locomotive—completely Timken-equipped—in leading truck wheels, driving wheels, trailer wheels, tender wheels, booster, speed driver of valve pilot and train control governor.

TIMKEN BEARING EQUIPPED

MODERN TRANSPORTATION ROLLS ON TIMKENS

Swiftly . . . smoothly . . . silently . . . the modern train gathers speed or slows to a stop without a jar or jerk. Looking for the reason, student engineers find Timken—the same bearing that has licked the toughest jobs throughout all Industry—the most powerful weapon available to them in their future war against mechanical waste and inefficiency.

In railroad cars Timkens have justified their use and proved their supremacy in one hundred million car miles of travel on one railroad alone.

And why not? For thirty years and more, Timken Bearings have reigned supreme over friction; have carried not one type of load, but *all* loads—radial and thrust—measured in pounds or thousands of tons.

In the air and on the water, by road and rail, Timken tapered construction and Timken-made steel roll on to new triumphs—saving power and lubricant . . . promoting dependability . . . assuring extreme economy of maintenance with supreme defiance of depreciation.

In train service they afford the luxury of smooth, silent travel, with starting resistance reduced 88%.

One hundred and thirty-four railroads are now using or testing Timken Bearings, so it does not seem a far cry to the time when *all* transportation—passenger cars, freight cars, mine cars, motor trucks, buses and motor cars will be traveling totally Timken Bearing Equipped. They will not be *modern* unless they are. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* BEARINGS

Cultural Aims In an Engineering Education

(Continued from page 8)

All of this is not gained in a short four years of college. A lifetime may not suffice. But one will become a leader of men in direct proportion to the attainment of these qualities. Such a person, if he has gained the technical equipment, cannot fail to be a great engineer, for in practice he can measure up to the definition of engineering—"the art of organizing and directing men and controlling the forces and materials of nature for the benefit of the human race."

What in the college engineering curriculum makes for cultural training? First, we have the so-called cultural subjects. And the committee investigating engineering education for the Society for the Promotion of Engineering Education has designated as cultural subjects the group of non-professional, humanistic subjects which include English literature, history, economics, foreign language, and the like. It by no means follows that the engineering subjects themselves lack cultural value; in fact, the teaching of science, mathematics, or engineering may be, and often is, more liberalizing than routine drill in some of the subjects named as cultural.

The personality of the instructor determines to a very great extent whether a subject is truly cultural. In many cases the subject would have more cultural value for the student if he read it by himself and was not influenced by a teacher with whom he was not in sympathy. For then the author alone would exert the influence. A page may be read and re-read and puzzled over and the author will not scold and become crabbed.

Every college graduate will affirm that much of the benefit he gained in certain subjects was not from a knowledge of the subject matter so much as from his contact with a sympathetic, thoughtful teacher of noble personality. One who by casual remarks and actions impressed him with the thought that man's life does not consist only in the abundance of things possessed—that we do not live by bread alone. A true teacher leads his pupils to think. If one is supplied a thought, he may remember it and he may not; but, if he can be made to think a thought for himself, he has indeed added to his stature.

Besides the cultural subjects which should constitute a prescribed part of the curriculum, and which at present constitute about nineteen per cent of the required subjects of the engineering curriculum—this being the average in the United States, there are numerous extra-curricular activities which make for cultural training, develop character, improve personality, and truly prepare one for life. To mention some of these, there is the privilege to serve on the college publications with all the possibilities for growth they offer; there are the athletic activities with the advantages for developing manliness; there are the students' engineering societies and musical organizations which afford means for self expression in various ways; there are the fraternities and clubs in which lasting friendships are formed.

Solitude

Laugh, and the world laughs with you;
Weep, and you weep alone;
For this brave old earth must borrow its mirth,
It has trouble enough of its own.
Sing, and the hills will answer;
Sigh! it is lost on the air;
The echoes bound to a joyful sound,
But shrink from voicing care.

Rejoice, and men will seek you;
Grieve, and they turn and go;
They want full measure of all your pleasure,
But they do not want your woe.
Be glad, and your friends are many;
Be sad, and you lose them all.
There are none to decline your nectared wine,
But alone you must drink life's gall

Feast, and your halls are crowded;
Fast, and the world goes by.
Succeed and give, and it helps you live
But no man can help you die.
There is room in the halls of pleasure
For a long and lovely train;
But one by one we must all file on
Through the narrow aisles of pain
—Ella Wheeler Wilcox

Much of what has been set forth here consists of the viewpoints and expressions of an individual, and as such is worth no more than the opinions of one man and therefore debatable. They are, however, based upon observations and experiences of some thirty years of more or less intimate contact with engineers and embryo engineers, coupled with a careful study of engineering education. All of this has emphasized the belief of the writer that an engineering education is the best system of training extant to develop a "full man."

The somewhat disconnected quotations which follow are less debatable, as they are from the findings and conclusions of the investigating committees which have made an exhaustive study of the whole field of engineering education, and are, therefore, the consensus of opinion of thousands of engineers and teachers of engineering.

"The bearings of engineering upon the broader problems of life should be implicitly impressed upon the student by frequent comments and allusions introduced by the teachers in regular courses of instruction in various subjects. They should be explicitly sought through special lectures, articles in student publications, student organizations, and recommended readings. The aim should be to inoculate the embryo engineer with a sense of social obligation which will survive any period of slavery to technical detail in his early experience and come to fruition in the more responsible years of his maturity."

"Engineering curricula aim to provide a thorough grounding in the principles of science and methods of engineering, together with elements of liberal culture intended to enrich the personal life of the student and fit him for a worthy place in human society."

"The next phase of the effort of the Society should be to awaken the public to the importance of engineering education and research as factors in individual and social well-being."

The final quotation is from an address by Eugene G. Grace, President of the Bethlehem Steel Corporation.

"Let us look at what is around us and look carefully. If we get the meaning of that which we are seeing from day to day and interpret that experience accurately, we are on the sure road to achievement. And if we go a little further as Steinmetz did, as Thomas A. Edison did, as Michael Pupin did, and not only see carefully what is around us and interpret it accurately, but are able then to project our minds into the field of the unknown, so that out of the seen we shall be able to gather a vision of the unseen; we shall then become truly great engineers and, perhaps, benefactors of mankind. For of such, I am proud to say, is the Kingdom of Engineers!"

OXWELDED PIPE JOINTS —as strong as the pipe

Modern piping design demands joints that measure up to the strength of the pipe itself. The oxwelded joint meets this demand in a thoroughly practical and economical way. It is strong and permanently tight. It fully justifies the high efficiency expected of it and has definitely taken its place as the standard means of pipe fabrication.

Progressive engineers demand the 100 per cent efficient oxwelded joint.

THE LINDE AIR PRODUCTS COMPANY, THE PREST-O-LITE COMPANY, INC., OXWELD ACETYLENE COMPANY, UNION CARBIDE SALES COMPANY,

Units of UNION CARBIDE AND CARBON CORPORATION

General Offices . . 30 E. 42nd St., N. Y. UCC Sales Offices . . . in the Principal Cities

65 Linde plants . . . 48 Prest-O-Lite plants . . . 174 Oxygen Warehouse stocks . . 156 Acetylene Warehouse stocks . . . 42 Apparatus Warehouse stocks . . . 245 Union Carbide Warehouse stocks

The Power Industry

(Continued from page 8)

practical overall thermal efficiency of 90 per cent. However, economizer and air preheater surface has been extended to the practical limit, and additional heat reclaiming equipment has reduced other thermal losses. Also, heat transfer and combustion have reached a refined stage in latest boiler plant design. Consequently, no further appreciable gain in commercial boiler plant efficiency is expected. Nevertheless, many opportunities remain for perfecting the existing equipment and reducing invested capital and operating costs. High rates of heat release accomplished with water tube wall and pulverized coal furnaces have produced immense capacities and high temperatures, yet outage due to refractory failure has remained at a minimum. Unit investment and operating costs have thus been materially reduced.

Further substantial gains have been made in the turbine room where inter-stage reheating has permitted the use of high pressure steam at moderate temperature without erosion of the blades in the final stages. Pressures and temperatures of 1,400 lbs. and 750°F. have increased turbine efficiency and have stimulated regenerative feedwater heating and use of process steam. Advance of temperature to 1000°F. will, according to theory and experiment, reduce station heat rates another 2,000 B. t. u. per kilowatt hour without any appreciable addition in plant investment. The efficiency gained by an increase in pressure alone above 1,000 lbs. is not warranted by the additional investment in equipment. However, with the use of special heat resisting alloys, forged boiler drums, and all practical heat reclaiming apparatus, operation at high tempertures and high pressures is feasible, and good efficiencies may be obtained. Economic gains are thus realized in reduced fuel consumption and other operating costs.

Inspired by the possibility of surpassing such records as the 28 per cent efficiency of Powerton, engineers are investigating every possible means of improving the performance of heat power equipment. Research on the use of high temperatures is undoubtedly the most promising, but the attention to other matters such as the use of generator heat, combustion, and turbine losses will certainly improve efficiencies.

The latest design in efficiency heat cycle development is the 10,000 kilowatt mercury vapor unit of the Hartford Electric Light Company. A closed cycle mercury unit, operating at 70 pounds pressure and 880°F., exhausts into a high vacuum condenser that serves also as the boiler for the steam plant. The mercury unit is thus able to operate in the high temperature field and generate as a by-product, 129,000 pounds of steam at 280 lbs. pressure, per hour. The steam is then heated to 735°F. and delivered to the mains for use in the steam driven turbine generators. The remarkable heat rate of 9,000 B. t. u. per kilowatt hour has been obtained during base load operation.

A powdered-coal burning air-cooled furnace fed by three unit mills is characteristic of the simple and automatic features of the plant. Outage of the mercury vapor turbine, condenser, or boiler is eliminated, due to the absence of scale forming and erosion producing qualities of the medium. Gravity return supplants the feed pump and additional valves and regulators, contributing to the ease of starting.

Who Loves the Rain

Who loves the rain,
And loves his home,
And looks on life with quiet eyes,
Him will I follow through the storm;
And at his hearth-fire keep me warm;
Nor hell nor heaven shall that soul
surprise.
Who loves the rain,
And loves his home,
And looks on life with quiet eyes.

—*Francis Shaw*

Complications present in many less efficient steam plants are not found in the mercury vapor plant; thus more reliability and better economy are realized. The field of application for mercury vapor units is promising, due not only to an efficiency much higher than that obtained with other heat power equipment, but also to remarkably low maintenance costs which careful design and simplicity permit.

In the power industry, as in human life, perfection seems never to be reached. There has been extensive development in Diesel engines, hydro-electric plants, and steam power plants, but it is quite apparent that ultimate refinement has not been attained. Each mode of power generation has its own field of application, but all have contributed nobly to the advancement of civilization.

The Prior Art

(Continued from page 13)

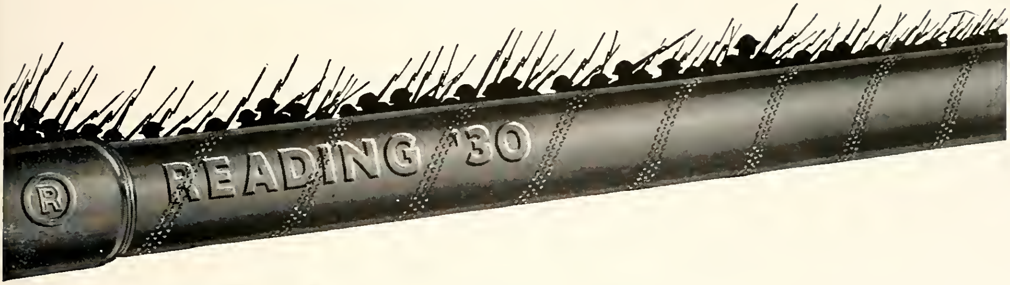
This generalization is, however, of little value unless it is kept in mind that the material embraced in the prior art differs for each invention and its effect is different with respect to the same invention in different countries. It is for this reason that in speaking of the date of an invention as the boundary line between invention and the prior art, consideration must be given to a particular invention and a particular country.

In determining the prior art with reference to a particular invention, we are concerned not merely with the date upon which the invention was conceived or first took definite form in the mind of the inventor but with the effective date, which is a very different thing. In some countries this effective date is the date upon which the application is filed, and publication of any kind or public use of the invention anywhere prior to this date is considered as prior art. In others, the publication or use must have been within the country to be prior art. In the United States, the effective date is the date upon which the invention is completed. Although the granting of a valid patent may be barred by statute because of publications, patents, public use, or sale subsequent to the date upon which the invention was completed, if an application is not filed within two years, these are statutory bars, and it is erroneous to call them part of the prior art as is often done.

In an effort to remove, in a measure, the hardship placed on an invention by the material variations in the patent statutes of various countries, an international agreement, known shortly as the "Patent Convention" has been entered into by most of the important countries of the world. It provides that an application for patent filed in one of the contracting countries within a year of the first filed foreign application is granted an effective filing date corresponding to the actual filing date of the first application. An application filed January 2, 1928, in the United States, for example, entitles the inventor or his assignee to an effective filing date in France also of January 2, 1928, provided the actual filing in France is effected prior to January 2, 1929. Thus publication or use within the "Convention" year prior to the actual filing date in France, is excluded

(Continued on page 32)

Millions of
Tiny Barriers say—



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GENUINE PUDDLED WROUGHT IRON
READING PIPE
DIAMETERS RANGING FROM ⅛ TO 20 INCHES

Science and Invention Have Never Found a Satisfactory Substitute for Genuine Puddled Wrought Iron

The Prior Art

(Continued from page 30)

from the prior art by operation of the Convention.

Space does not permit a discussion of the provisions of the patent laws of the various signatory countries making the Convention effective or of the legislation enacted to extend Convention priority over the period of the World War. Under special conditions, such extensions have the effect of excluding much from the prior art which otherwise would be included.

Sufficient has been said of the more striking differences of the patent statutes in the more important countries to indicate that to obtain complete patent protection on an invention, certain precautions should be observed with reference to publication, public use, or sale. Unless these precautions are observed it may well happen that in one or more countries the invention will be prematurely added to the prior art.

The safe procedure, if world wide patent protection is contemplated, is to make sure that applications for patents are filed in all countries where protection is desired before the invention is either patented, published, used, or sold in any country. If circumstances do not permit following this preferred procedure, the first filed application should precede publication, use, or sale, and the remaining applications should be filed within the Convention year.

Engineering News

(Continued from page 15)

er-than-air craft, this is the largest structural application of aluminum to date.

The design of the crane was based largely upon the usual practice followed in building steel cranes, although certain departures were necessary in the case of the bridge girders, since aluminum and steel differ in some of their mechanical properties. While the strength of structural steel and of the heat-treated strong aluminum alloys is approximately the same, the modulus of elasticity of the latter is almost one-third that of the former. Because of this fact, an aluminum girder will deflect about three times as much as will a steel girder, if both have identical cross sections and loads.

No fabrication difficulties were encountered in the building of this new crane. The same equipment ordinarily used for steel girders was used in the shearing and flattening of the aluminum alloy. The rivet holes were sub-punched and then reamed to size. Hot steel rivets, three-quarters of an inch in diameter, were used throughout, all of them being driven with air-operated squeeze riveters, except for some of the more inaccessible ones, which required pneumatic hammers. No difficulty was experienced in riveting the girders, although a few special precautions were taken. For instance, excessive rivet temperatures were avoided to decrease the possibility of drawing the temper of the aluminum plates. In order not to concentrate the heating effect of the rivets and keep the girder straight the rivets were driven at random in the assembly of the box girder.

After completion of the aluminum crane a steel crane was placed beside it for comparison. The two cranes were similar in design with the exception of the girders. The moment of inertia of the aluminum section about the horizontal axis based on the gross area is approximately 21 per cent greater than that of the steel section. The total weight of the steel crane was 46 tons compared to 34 tons for the aluminum. Twelve tons is a saving in dead weight worth while considering. In the construction of the aluminum crane no castings of the trolleys and end trucks were available, so steel was used. If such parts were replaced by the alloy the total dead weight saving would be about 20 tons. Such a saving means a corresponding reduction in the supporting members which are several hundred feet long. The light weight of the crane also means a reduction in the power used, owing to the smaller inertia to be overcome in starting and stopping the crane.

On a Faded Violet

The odor from the flower is gone,
Which like thy kisses breathed on me;
The color from the flower is flown,
Which glowed of thee, and only thee.

A shriveled, lifeless, vacant form,
It lies on my abandoned breast,
And mocks the heart which yet is warm,
With cold and silent rest.

I weep—my tears revive it not!
I sigh—it breathes no more on me!
Its mute and uncomplaining lot
Is such as mine should be.

—*Percy Bysshe Shelley*

A New Valve Seat Material Is Found

All of us know the conditions under which many of the steam valves used in modern practice are put. The seating metal must often withstand high temperature and pressure conditions.

Hardness is quite an essential factor in the use of a material for a valve rest. Case-hardened steel, with a 700 Brinell test, makes a good seating metal as far as hardness, seizing, or tearing are concerned, but it is not non-corrodible, and a valve seat which rusts under ordinary conditions of moisture is impractical.

A new seating metal, nitralloy, has been found for such purposes. It is a forgeable steel containing small proportions of chemical elements which cause the surface of the alloy to become glass hard when heated to 900 or 1,000 degrees F. for several hours in a stream of dry ammonia gas. This case or coating, which usually is from 0.01 to 0.03 of an inch thick, depending on the length of the nitriding treatment, is non-corrodible under ordinary circumstances. It also does not seize or tear, and has the peculiar advantage of becoming smoother the longer it is in use. Nitralloy gives very satisfactory results in steam service and in the oil cracking industry, as it is resistive to sulphur vapors.

Photograph Sun in Eclipse

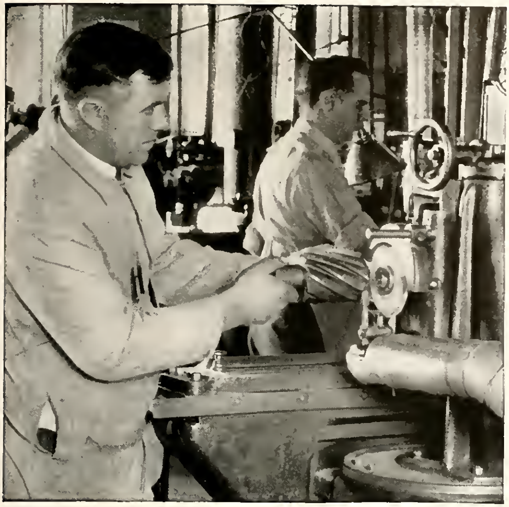
After several weeks of patient waiting, American astronomers on the Niuafou Island in the South Pacific, were finally rewarded when they succeeded in taking 41 photographs of a total eclipse of the sun.

San Franciscans reported that the eclipse of the sun interferred with radio communication over the Pacific. Hours after the phenomenon was to have been observed at Niuafou Island no word could span the ocean.

The effect of eclipses of the sun on radio communication is one of the scientific mysteries that awaits solution. Radio experts have struggled to solve this mystery, but have found rather unsatisfactory results.

U. of C. Professor Studies Meteor

Dr. Forest R. Moulton, former University of Chicago professor, in studying the meteor crater near Winslow, Arizona, has formed the opinion that the crater, nearly a mile in diameter, was produced by about 300,000 tons of meteors.



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Left Fig. 162 Jenkins Extra Heavy Iron Body Globe Valve, flanged.

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Some Notes on the Aims of An Engineering Education

(*Continued from page* 11)

but there is as yet no satisfactory one. In the following discussion the definition that adorns the walls of the library of the United Engineering Societies, in New York City, will be considered. It is as follows: "Engineering—the art of organizing and directing men and of controlling the forces and materials of nature for the benefit of the human race." This calls engineering an art; others call it a science. It is so comprehensive that a rancher, a gentleman farmer, an architect, and even an economic geologist could be included. The line of demarcation between applied science and engineering is indeed not well defined. It is sad that some scholarly engineer cannot think of a definition, comprehensive enough to include all the members of the ever increasing profession, and simple enough to be understood and not misunderstood by the general public. We may criticize our use of the word "engineer" as applied to a "locomotive driver," but after all, he can be included among the engineers if the definition is correct. He has the art of directing men, the fireman and himself, and he surely controls the iron monster under him, and we trust him to deliver his passengers and baggage safely to the division point. Professional engineers are charitable enough to include the architects, geologists, and even farmers, but should draw the line on including engine drives, salesmen (sales engineers), furnace men (school custodians), and others too numerous to mention under the term of engineer.

The definition as stated, divides itself into three parts: first, the art or perhaps the technique of organizing and directing men; second, the technique of controlling forces and materials of nature; third, the appraisal of their benefits to mankind. The self-made men, as leaders of industry, even the men in public office, are being gradually but surely replaced by engineers who, with their technical training, with their knowledge of the "engineering method" and ability to analyze, can understand the practical side of industry and public works, and who by their personality can earn the respect and cooperation of their fellowmen. More and more, industry and public life are looking to the engineer for direction and guidance. It was perhaps for this reason that the part of the definition pertaining to men was added to the definition proposed by Thomas Tredgold in 1827.

The engineering colleges should take a part in the shaping of young men to meet this quality of leadership. There are a few colleges that have set up curricula for the teaching of Administrators and Executives. These ordinarily consist of the usual fundamental studies of engineering to which have been added courses in business, accounting, finance, more economics, philosophy, psychology, statistical methods, time study, etc. These courses are truly desirable for any student who aims to be a leader of men but seem hardly to bring out and develop qualities of leadership any more so than a course in Structural Design. The faculty of leading and directing men appears to be an indefinable attribute, like personality. Not all our engineering graduates will be great leaders of men; they do not have the personality nor this quality for leadership. However, since this quality for leadership is a necessary part of the training for some engineers, one aim of engineering education should be to teach this quality, but such instruction will be limited to few students. A young man with a fine personality, a personality that is distinctly agreeable rather than disagreeable, a young man than can forbear rather than leap at conclusions, a team worker rather than a trouble maker, one endowed with a mind of deep insight and good judgment, has all the attributes of an executive or administrator. Such characteristics are not described in text books and our faculties can impart them only by example. As Mr. Wickenden would say, this leads into the delicate ground of teaching personnel. Here again we are not so fortunate as the European nations where the public office seeks the man, where recognized leaders in the engineering profession welcome the higher responsibilities and public honors that go with teaching of engineering students.

Life

Life, believe, is not a dream,
So dark as sages say;
Oft a little morning rain
Foretells a pleasant day:
Sometimes there are clouds of gloom
But these are transient all;
If the shower will make the roses bloom,
Oh, why lament its fall?
Rapidly, merrily,
Life's sunny hours flit by,
Gratefully, cherrily,
Enjoy them as they fly.

What though Death at times steps in,
And calls our Best away?
What though Sorrow seems to win,
O'er Hope a heavy sway?
Yet Hope again elastic springs,
Unconquered, though she fell;
Still buoyant are her golden wings,
Still strong to bear us well.
Manfully, fearlessly,
The day of trial bear,
For gloriously, victoriously,
Can courage quell despair!
—*Charlotte Bronte*

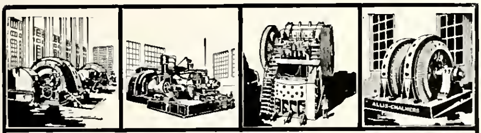
Our extra curricular activities do a great deal towards bringing to the front those students who have the elements of leadership in their make-up. The industries that are interested in a student's activities outside of his studies as well as their scholarship, know that the outside activities, be what they may, are a measure of this quality of leadership.

For the second qualification of an engineer, the teaching of the technique for the control of materials and forces of nature, the technical colleges are well prepared. In this recent investigation of the S. P. E. E. very little fault was found in this respect with colleges as a whole. The consensus of opinion indicated that moderate specialization, i. e., the division into departments of M. E., E. E., C. E., and Ch. E. was about what it should be, although there was a definite stand against too much specialization. Four years of training seems to suit industry in every respect, being of sufficient length to permit a student to acquire the rudimentary knowledge of the subject and yet not deferring beyond maturer years, his adjustment to practical life. For those who wish to specialize on a particular subject or trend, or those who wish to spend their days in study and research, there is ample opportunity in many colleges. The schemes of study at Armour needed very few changes to bring them up to the recommendations of the investigation committee. The fundamentals, mathematics, chemistry, physics, and English are stressed as much as time will allow. The technical subjects such as mechanics, drawing, mechanics of materials, hydraulics, heat power engineering, and electricity have their full share in the busy life of a student. The purely engineering subjects begin in the sophomore year and hold full sway in the senior year. It was strongly recommended that a band of humanistic subjects should extend throughout the four years. This band could be wider than it is and young men would find their place in society and become perhaps happier and more useful citizens if more stress were placed on these subjects, but when a course is limited to four years or 140 semester hours it becomes a question as to what fundamentals or technical subjects shall be curtailed to make room for more of the humanities.

The estimation of costs, the appraisal of values for the benefit of mankind, can be taught only indirectly. Economics, especially engineering economics, is the subject that deals most directly with the third qualification of an engineer. Engineering economics need not be taught as a separate and distinct subject,—it can be included in the problems of other subjects. It is a lamentable fact that primarily because of our "task" system of instruction the "dollar and cents" side of a problem and the economic reasons for the given data can hardly be given consideration. It is too bad that the item of cost can enter so little in a problem in design, say of a bridge or power plant. Somehow or other the money for any project must be in sight before design is begun. Someone must determine whether a project is financially possible or profitable, or whether the tax payers can be induced to burden themselves further. Someone must determine where a bridge is needed and where it can be built, and what its probable load will be. A municipal engineer is often called on to design a sewer system to match the purses of the taxpayers, but in the class room a design of a sewer system is carried out without regard to expense. Finance, taxation, amortization, capitalization, obsolescence, stocks, and bonds are as necessary to the engineer as brick and mortar. How much time ought we to put on them? There is no more time; it has all been used.

How much we would like to do in educating young men to become engineers were the time available! The student who does his assigned work conscientiously has less leisure for recreation and collateral reading than a day laborer. In spite of this we expect him to devote some of his time to extra curricular activities. In fact, industry demands from our graduates that they show a record of such activities. One often wonders at the accomplishments of some of our fine boys. Looking back to those who have graduated and have become good citizens and good engineers, and are happy in their work, I begin to think less of discussions on aims of engineering education and to feel less worried about the shortcomings of our instruction methods as applied to the making of executives. I have a greater regard for the personnel of the teaching staff, give the content of the curricula no thought at all, and feel almost sure that whatever our boys will do will be of benefit to mankind.

Perhaps the above is a rather pessimistic side of the picture. However, note the following: In 1916 the Carnegie Foundation summed up the opinions of 5,500 engineers on the essential characteristics of a successful engineer. They placed first such qualities as character, integrity, responsibility, resourcefulness, and initiative; next, judgment, common sense, scientific attitude, and perspective; third, efficiency, thoroughness, accuracy, and industry; and last, understanding men and executive ability, followed by knowledge of fundamentals of science and the technique of practice and business. Perhaps in our discussions of some phases of the aims of engineering, the cart has been placed before the horse. The three qualities implied in the definition of engineering, as previously quoted, seem to be of least importance!



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The Relation of Chemistry to the Refining of Oil

(Continued from page 9)

$C_{12}H_{26} = 6C_2H_2 + 7H_2 — 381,000$ cal.
$3C_2H_2 = C_6H_5 + 137,700$ cal.

But chemistry, given the hope of success, clung to the task with indomitable tenacity.

From Le Chatelier's law—which states that if a system in equilibrium be subjected to a stress (heat, pressure, etc.), the state of the system will tend to alter to relieve the strain—it is seen that temperature, pressure, and also time are factors which must be closely controlled if the desired products are to be secured. In the first types of cracking stills, these conditions were invariably such that besides the gasoline and light-oil distillates, coke, and uncondensible gases were formed in undesirable quantities. The danger incurred from coke formation soon manifested itself in boiler explosions and refinery fires. Extensive experiments varying these factors revealed to chemists the fact that the reactions might be halted before a great proportion of the troublous materials were secured. The stock, in that case, would then provide a reduced amount of gasoline, but less fixed gas and a certain amount of fuel oil which could be drawn off carrying most of the free carbon in suspension. Chemical engineers further abated the coke nuisance by so designing the apparatus that the cracking stock was not decomposed until it entered a "reaction" chamber, where any coke which was deposited was removed.

Relevantly, the development of the automobile has caused chemists to investigate fuels with the intent of improving their operating qualities. One of the most objectionable effects of some gasolines is the familiar "knocking." How many of

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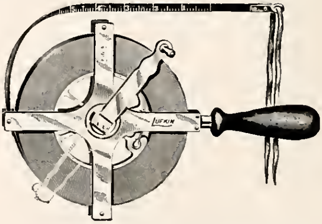

THE LUFKIN RULE CO.
SAGINAW, MICHIGAN

us have not been irritated by the "bang-bang" of our pistons as we drive at a merry clip over the highway? Theories for this occurrence are many, but it is generally conceded that slower burning fuels produce less "knock." Chemistry would lead one to expect that the cycle and unsaturated compounds which contain more of the slow burning element carbon should have a lesser tendency to knock—and such is the case. Of the hydrocarbons, the variety known as aromatics and naphthenes are the best in anti-knock quality, while the paraffins are the poorest. Cracked gasoline, which is rich in these aromatics, naphthenes, and unsaturated hydrocarbons, has found a fortunate use as a diluent of the straight-run "knocking" gasoline.

A cracking process which has been especially designed to yield a highly anti-knock distillate is the "vapor-phase" process. The temperature and pressure are so maintained that the decomposition reactions occur in an expansion chamber where the previously heated oil gasifies. Its one defect is in the large quantities of fixed gas formed.

That the efficency of the various cracking processes in use today is far from satisfactory may be surmised from the number of patents being conferred yearly, and the interest in contemporary research. A striking example of what the science of chemistry offers those engaged in investigation is found in the recent perfection of the process for catalytically cracking heavy oils by means of aluminum chloride. About 1915, Dr. A. M. McAfee of the Gulf Refining Company found that a very good grade of gasoline might be obtained by heating the cracking stock in intimate contact with anhydrous aluminum chloride. The process was favorably received, but at first proved unfeasible commercially since this chemical sold at $1.50 per pound and could not be profitably recovered after use.

Dr. McAfee, nothing daunted, and exhibiting that mettlesome spirit so appropriately dubbed "scientific," undertook the discovery of a method for reducing the cost of his catalyst. After expending four and a half million dollars in four years of painstaking, exhaustive work, disappointment, and development, his dream materialized into a practicality. Briquets of bauxite and bitumen are roasted; then they are heated to about 1600°F. and exposed to the action of gaseous chlorine. Sublimated aluminum chloride is obtained which condenses as a powder. The total cost of a pound is actually less than five cents; today the Gulf Refining Co. is operating its unique cracking unit economically and successfully.

The significance of the cracking processes becomes apparent when we reflect that thirty-two per cent of the gasoline which runs our indispensable automobiles is cracked gasoline. Moreover, in every instance, the principles of general and physical chemistry have guided the efforts of investigators.

The Indian Serenade

I arise from dreams of thee,
In the first sweet sleep of night,
When the winds are breathing low,
And the stars are shining bright.
I arise from dreams of thee;
And a spirit in my feet
Has led me—who knows how?
To thy chamber-window, sweet!

The wandering airs they faint
On the dark, the silent stream;
The champak odors fail,
Like sweet thoughts in a dream,
The nightingale's complaint,
It dies upon her heart,
As I must die on thine,
O beloved as thou art!

Oh, lift me from the grass!
I die, I faint, I fail.
Let thy love in kisses rain
On my lips and eyelids pale.
My cheek is cold and white, alas!
My heart beats loud and fast.
Oh, press it close to thine again,
Where it will break at last.

—Percy Bysshe Shelley

Few petroleum products are ready for commercial use when they are first distilled. Most must undergo treatment for the removal of injurious and foreign substances. In this treatment, chemistry plays the prime part. In 1855, Professor Silliman suggested a process which is still essentially the one used most commonly today. Light oils, and to a lesser extent, lubricating oils, are agitated with concentrated sulfuric acid, which reacts with the substances producing the colors, odors, and resins associated with inferior grades of products. The precipitate, or sludge, formed absorbs at the same time undesirable sulfur derivatives of organic compounds. The residual oil is washed with alkali and then with water to remove all traces of free reagent.

Chemists have long, however, been unsatisfied with the results of this orthodox procedure. In highly sulfurous oils, if increased amounts of acid were used to sweeten it, some of the oil would be lost in the sludge. Therefore, to supplement the acid treatment, lead plumbite (lead oxide dissolved in caustic soda) has been recommended as an auxiliary reagent. The sulfur content will be removed as insoluble lead sulfide. Also prominent among the recently developed purifying agents are alkaline hypochlorites. The oxidizing property of the hypochlorite is utilized to transform injurious substances to less deleterious ones.

The treatment of kerosene or of gasoline often differs. In motor fuels aromatic, cyclic, and unsaturated compounds are highly desirable because of their anti-knock properties, while in kerosene these same compounds will cause soot formation when burning in the ordinary type of lamps. The customary acid treatment is not sufficient to remove enough of these cyclic and unsaturated compounds from kerosenes—such as some California and Roumanian distillates—which contain a preponderance of these substances. Dr. Edeleanu, investigating Roumanian oils, successfully separated these compounds by employing the solvent properties of liquid sulfur dioxide. The kerosene thus treated was always clean in its combustion, and the compounds dissolved by the sulfur dioxide could be recovered as by-products.

The Edeleanu process is finding application in gasoline purification at present, since the liquid sulfur dioxide will remove most of the obnoxious sulfur compounds, and since the anti-knock compounds dissolved may be returned in any desired amount to a treated gasoline.

As a matter of fact, no process for commercially purifying cracked gasoline has yet been invented which is not accompanied, to a greater or lesser extent, by the loss of some of the anti-knock unsaturated and cyclic compounds. Filtration of the cracked gasoline vapors has been employed with a certain measure of success, but the refining industry looks forward expectantly to the intense work of their chemical researchers for more effective methods.

Lately chemists have directed their attention to the reduction of the corrosion hazard. Acidic constituents, particularly sulfur acids, weaken stills, not only endangering the lives of the workers, but necessitating replacement expenses. Notably in cracking stills, where the conditions of temperature and pressure are especially conducive to the formation of the products of corrosion, means of prevention must be taken. Often the acids are neutralized by lime or caustic soda before the stock is charged. The one serious defect of this procedure is the devaluation of the by-product sludge, which could otherwise be profitably used.

Corrosive resistant materials are also being used where the destructive action of the sulfurous compounds are most manifest. Alloy steels of various compositions have been found effective. Chrome steels received wide application, but it was found that welding marred the homogenity of that material and that the steel had a tendency to become brittle at high temperatures. The research department of the Krupp works in Germany has recently developed a steel containing about eighteen per cent of chromium and eight per cent of nickel, which represents a decided improvement in qualities. Not only are the defects of the simple chrome steels eliminated, but the corrosion-resistant properties, the durability, and the workability are increased.

No survey of the chemistry of petroleum refining is complete without lingering briefly upon its future possibilities.

The basic products of the petroleum industry, such as the fuels, lubricants, waxes, and vaseline, are so much in demand that chemists have paid little attention heretofore to the utilization of by-products or the synthesis of organic compounds from petroleum hydrocarbons.

The by-products that are most indicative of the potentialities of similar materials, which the chemist has not yet deemed wise to isolate, are the naphthenates, sulfonates, and their respective acids—obtained from the acid and alkali sludges of the treating processes. The chemist has found use for naphthenates in soap and wood preservative manufacture; sulfonic acids are widely used in soap industries.

That petroleum compounds are a fertile source of valuable organic derivatives is not questioned. Already ethyl alcohol has been synthesized from petroleum ethylene; rubber has been derived from butadiene, which had been isolated from the products of the cracking still; formaldehyde has been made by the oxidation of ethane; and explosives have been synthesized from the aromatics of cracked and natural oils. As economic conditions become propitious, the chemical utilization of the products and by-products of the petroleum industry will undoubtedly assume an importance and direction analogous to that of the remarkable coal-tar industry.

Certainly, whether the development of the petroleum industry flows in the expected channels, or is checked by the much-feared shortage in the crude oil supply, the petroleum industry in general, and the refining industry in particular, look toward chemistry and its students for guidance and achievement.

1855 · SEVENTY-FIFTH ANNIVERSARY · 1930

Metal on trial

In the laboratories of scores of foundries and rolling mills, a constant search is being conducted for a metal that is stronger, more resistant to temperature strains, and more economical to produce. Almost as constantly the compounds and alloys so developed are being brought to Crane Co. for trial.

The court that passes on them is composed of the most experienced Crane designers, metallurgists, and engineers. Under its direction bars of the new metals are carefully tested for ductility, reduction of area, elastic limit, and yield and breaking points. Hardness, transverse strength, and torsional strength are measured, behavior under temperature strains is determined by "1000-hour creep tests."

When the findings of all tests are favorable, the metals are made into valves and fittings for trials in the Crane plant that will approximate actual working conditions. Then, Crane Co. sends out these new materials to certain engineers who are interested in advancing piping practice. They use them in actual service: observing them over long periods, sending full reports to Crane Co.

Not only do materials thus developed serve all industry. They have contributed to a vast library of engineering data on metals and their capabilities. Much of this is embodied in a book, "Pioneering in Science," a valuable reference manual for students. Let us send it to you.

Valves CRANE *Fittings*

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The Furka and Grimsel Passes of Switzerland

(Continued from page 6)

everlasting snow. It is possible now by means of that wonderful engineering feat—the Jungfrau Cable Railway—to reach the very summit of this gorgeous mountain. We must not forget our visits to the two valleys, the Lauterbrunen and the Grindelwald. At the end of the Grindelwald we are rewarded by seeing one of the finest and most celebrated of all Swiss glaciers, known as the Grindelwald Glacier.

Perhaps on our way we have had the opportunity of hearing some Swiss peasant blow his Alpine horn and hearing the wonderful echo as it is thrown back from the mountain walls

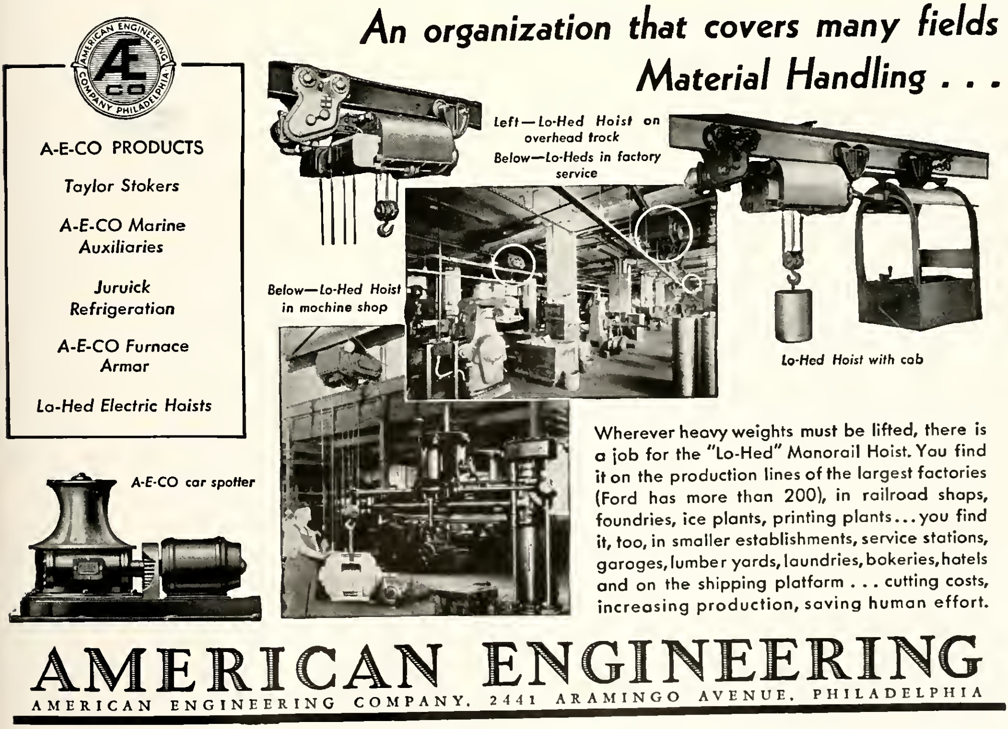
In the Lauterbrunen trip you will see and hear the mighty Truemmel Back Falls, one of the largest and most beautiful water falls in Switzerland. The noise of the water as it strikes the mountain side is almost deafening.

If anyone can make this trip without feeling himself blessed, and without becoming intoxicated by the beauty of the world, he is irredeemably prosaic.

ARMOUR TECH ATHLETIC ASSOCIATION

Treasurer's Report, College Year 1929-30

Receipts			
Cash Balance, September, 1929			$ 5,729.01
173 Senior Student Fees, at $7.50, 1st Semester		$ 1,297.50	
668 Student Fees, at $8.50, 1st Semester		5,678.00	
		6,975.50	
Less Class Dues		668.00	6,307.50
168 Senior Student Fees, at $7.50, 2nd Semester		1,260.00	
626 Student Fees, at $8.50, 2nd Semester		5,321.00	
		6,581.00	
Less Class Dues		626.00	5,955.00
Interest on Bank Balance			282.48
			$18,273.99
Expenses			
"A" Blankets		108.00	
Armour Engineer	$2,662.88		
Advertisements and Subscriptions	1,872.62	790.26	
Baseball		36.00	
Basketball		272.00	
Boxing		30.60	
Cycle	3,800.07		
Adv., Sale of Books and Donations	1,337.32	2,462.75	
Directors and Coaches		4,697.00	
General Expense		564.34	
Golf		241.25	
Medical Expense		10.00	
Musical Clubs		354.05	
Rifle Club		65.60	
Swimming		100.54	
Tennis		335.53	
Track		523.86	
		$10,591.78	
Cash Balance	$8,338.24		
Less Class Balances	656.03	7,682.21	$18,273.99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Lo-Hed Electric Hoists

Left—Lo-Hed Hoist on overhead track

Below—Lo-Heds in factory service

Below—Lo-Hed Hoist in machine shop

Lo-Hed Hoist with cab

A-E-CO car spotter

Wherever heavy weights must be lifted, there is a job for the "Lo-Hed" Monorail Hoist. You find it on the production lines of the largest factories (Ford has more than 200), in railroad shops, foundries, ice plants, printing plants... you find it, too, in smaller establishments, service stations, garages, lumber yards, laundries, bakeries, hotels and on the shipping platform . . . cutting costs, increasing production, saving human effort.

AMERICAN ENGINEERING

AMERICAN ENGINEERING COMPANY. 2441 ARAMINGO AVENUE, PHILADELPHIA

Building Stadium for 1931 Olympics

KOEHRING
Pavers, Mixers; Power Shovels, Pull Shovels, Cranes, Draglines; Dumptors.

INSLEY
Excavators; Concrete Placing Equipment; Cars, Buckets, Derricks.

T. L. SMITH
Tilting and Non-tilting Mixers, Pavers, Weigh-Mix.

PARSONS
Trench Excavators, Backfillers.

C. H. & E.
Portable Saw Rigs, Pumps, Hoists, Material Elevators.

KWIK-MIX
Mixers — Concrete, Plaster and Mortar.

At Los Angeles, the coliseum in Exposition Park is being enlarged to a seating capacity of 105,000. When completed in 1931 for the Olympic Games, this giant stadium will be one of the largest in the world.

Three N. E. C. products were selected in providing efficient plants for handling excavation and concrete requirements. A Koehring Heavy Duty Shovel speeded progress on the earth work. Two Smith 14-S Tilting Mixers were installed for mixing concrete, one on each side of the stadium.

National Equipment Corporation, the greater name in construction equipment, aids man in carrying out his engineering achievements.

"Concrete — Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, will be gladly sent on request to engineering students, faculty members and others interested.

NEC

National Equipment Corporation Milwaukee Wisconsin

GLUE

....In Industry

THE manufacture of glue is an industry as old as the ages. The pages of history disclose, three thousand years ago, the cabinet makers of ancient Egypt laboriously putting together the various parts of their handicraft with a crude form of glue, made under most primitive methods.

3000 years ago . . . . Meanwhile the processes of evolution have transformed ancient Egypt into the modern world; research and science has made commonplace to us today that which would have been miraculous in ancient or medieval times; production and marketing methods have advanced to a basis of scientific control;—but glue and glue-making were not a part of this transition.

Thru the ages, glue remained glue, with little regard for the raw material from which it came and the quality of the finished product.

Then a consciousness was awakened to the difference between glues made from the hides of animals and glues made from their bones. Then, gradually, users began to make certain crude tests of various elementary qualities, but these tests relied primarily on the physical senses, and were usually unreliable.

Only a few years ago, comparatively, was glue finally lifted out of crude speculation as to quality and elevated to an exact scientific method of grade measurement. The laboratories of Armour and Company, in cooperation with one other laboratory, were the pioneers who developed the new methods that have since been recognized the world over . . . . and indeed have recently been accepted as standard by the United States Government.

Armour and Company has also pioneered in adapting the form of glue more specifically to the user's needs. For generations, glue was delivered to the user in a flake form. Then came ground glue—only comparatively recently, however. This speeded up his production and was, in many cases, much more practical for his own purpose. Within the last decade, a new process has been invented. It gives the manufacturer glue in the form of a small pearl, combining all of the advantages of both flake and ground glue in a product that permits a further speeding up of production and at the same time guarantees a cleaner and purer product.

Armour and Company were the first to introduce Pearl Glue on a wide scale in this Country and at the present time is the only manufacturer from whom an appreciable supply of this glue is available.

Likewise in marketing practice Armour and Company have left the beaten paths to lead with new ideas.

A staff of trained chemists is maintained for the purpose of contributing the latest thought on good and economical glue practice. Scores of special problems weekly find their way from the manufacturing field to the Armour Laboratories, and painstaking reports are returned giving constructive help.

Out in the field, in addition, Armour and Company maintains chemical engineers who go wherever they are needed, on request, to analyze plant equipment, gluing procedure, and adaptation of grade of glue. Their sole purpose is to give assistance in improvement of finished quality or reduction of manufacturing cost.

So to the industrial engineer and to the student who seeks to bring the wisdom and logic of science to the performance of the task in hand, we say:

If it involves the use of glue, let our technical service give you the benefit of a prolonged and varied experience. Take advantage of our numerous resources which are always available to you.

ARMOUR GLUE WORKS

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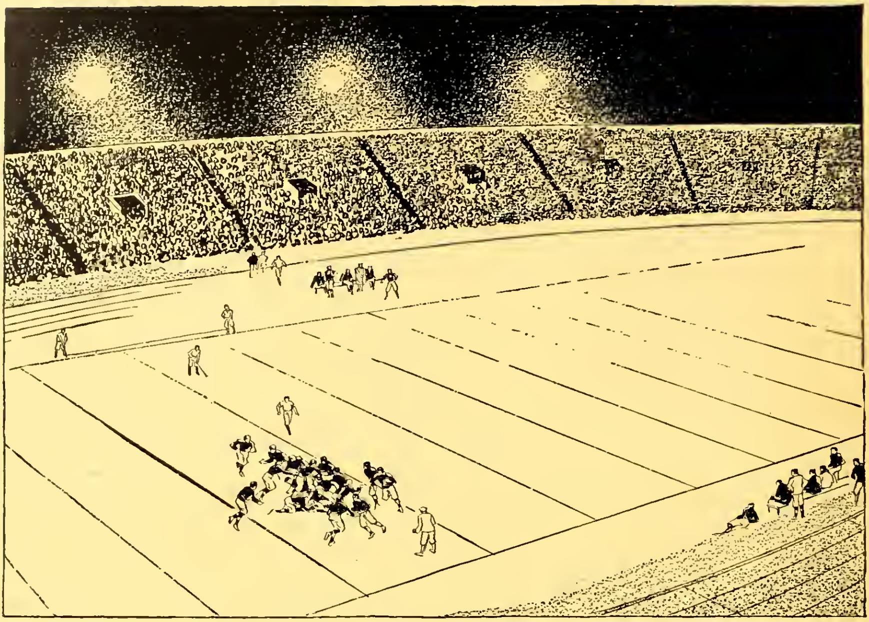
ARMOUR AND COMPANY

1355 W. 31st St., Chicago, Ill.



The banks of G-E floodlights at Georgia Tech's Grant Field can be adjusted to illuminate track meets as well as football games.

G-E Floodlighting Wins Favor for
Football - Hockey - Track - Baseball - Tennis

G-E floodlighting equipment has a winning record. Its victories are counted in terms of pleased spectators, increased attendance, satisfied coaches and players.

The development of G-E athletic-field floodlighting equipment was planned with every consideration for the fundamental and special playing conditions it must meet. That is why the big Novalux projectors give ample and evenly diffused light over the entire playing area.

The development of General Electric floodlighting equipment has largely been the work of college-trained men in the G-E organization —other college-trained men are largely responsible for the continuing leadership of General Electric in furnishing the many other products which bear the G-E monogram.

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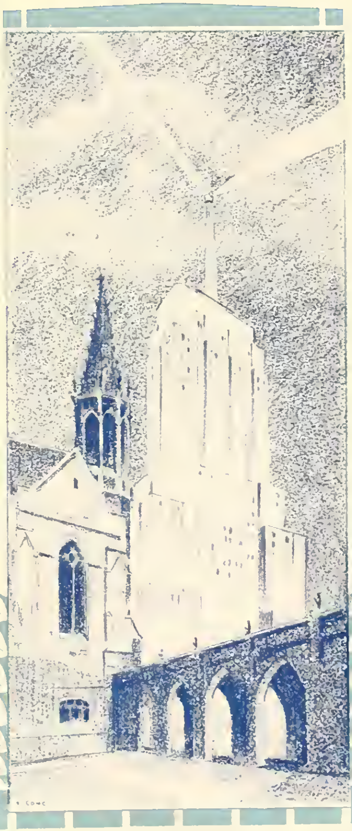
The ARMOUR ENGINEER

VOLUME XXII
No. 2

JANUARY
1931



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Member of Engineering College Magazines Associated

Building Giant Flood Gates

TWENTY-EIGHT miles upstream from New Orleans a great flood gate known as the Bonnet Carre spillway is being completed. In times of high water this concrete dam on the east bank of the Mississippi will tap the flood before it reaches the city, diverting the dangerous excess into Lake Pontchartrain.

The Bonnet Carre spillway consists of a concrete dam and a pier-and-weir section about 7700 feet long. The weir sections, which are twenty feet wide between the piers, have timber needles on the crests at two levels — elevations 16' and 18 A traveling crane, on a bridge spanning the piers, removes the timber needles for discharge.

N. E. C. equipment played an important part in the construction set-up. Two Koehring Cranes handled aggregate at the material bins and a third Koehring placed the concrete with an Insley bucket. Two large Smith mixers mixed the 127,000 cu. yds. of concrete used on the project.

Wherever you find construction work in progress, you find N. E. C. equipment!

NEC

"Concrete—Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, will be gladly sent on request to engineering students, faculty members and others interested.

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Mixers — Concrete, Plaster and Mortar.

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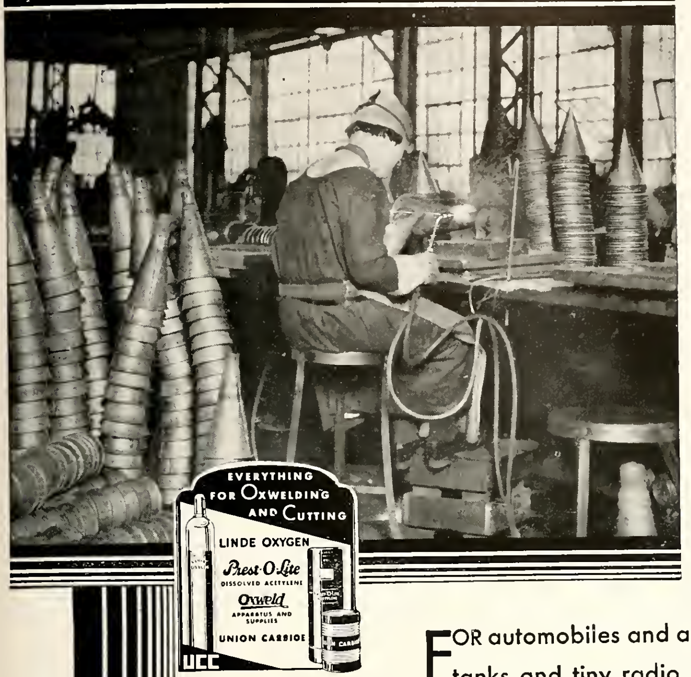

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Short Cut
to Production
Economy

FOR automobiles and aircraft, for giant pressure tanks and tiny radio tube filaments, throughout the whole range of the metal working industries, oxy-acetylene welding is being adapted to production processes.

More efficient products, more quickly made—reduction in unit production costs and capital expenditure for equipment—these are some of the many outstanding advantages that are obtained through the use of oxwelding.

Our service or development engineers can help you to apply oxwelding profitably to your production work.

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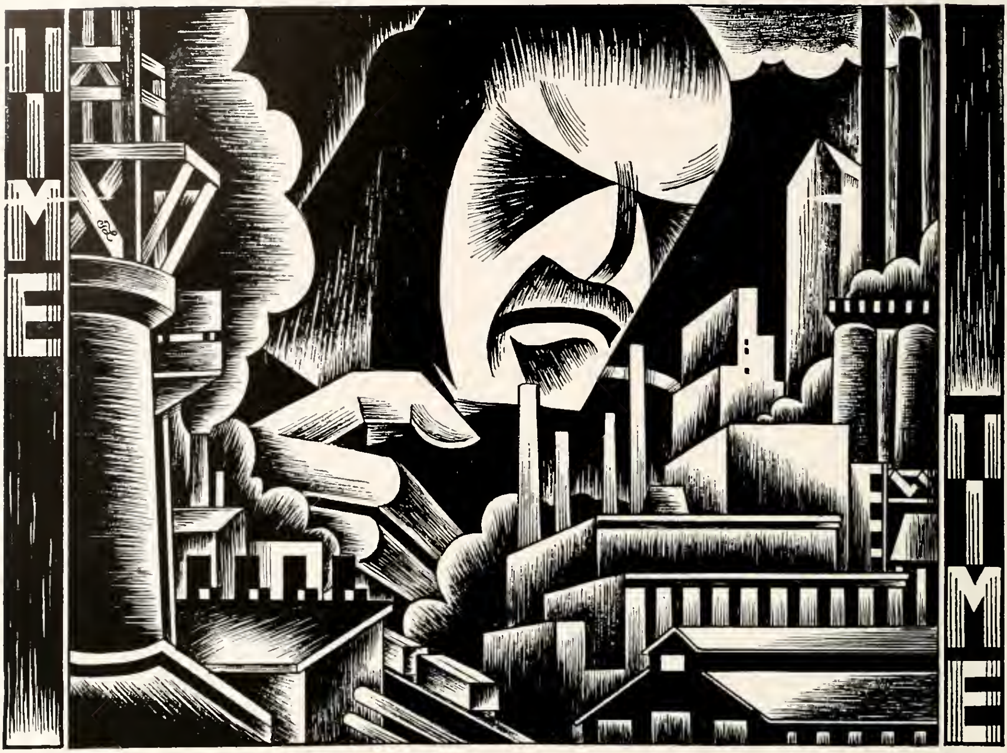

WHERE THE CHIMNEYS LOOM LURKS TIME, THAT TOUGH OLD TESTER

Where the chimneys of industry loom black against the sky, Time, That Tough Old Tester, draws his deadliest weapons. With acids and alkalies, with shattering vibration and ceaseless strain, he here attacks the works of man with greater eagerness, to prove how long things last.

And here, amid the mightiest of Time's destructive forces, you will find Reading 5-Point Pipe . . . resisting corrosive gases and fluids . . . absorbing shock and strain in its tough, fibrous structure . . . lasting from two to five times longer than ordinary pipe under Time's severest tests!

For Time . . . That Tough Old Tester . . . must stay his hand before Reading 5-Point Pipe, whether he finds it installed above ground or below. The long generations have shown that Genuine Puddled Wrought Iron, the material of which this pipe is made, defies Time's onslaughts as does no other. That is why Reading 5-Point Pipe means enduring economy, enduring satisfaction.

READING IRON COMPANY, Reading, Pennsylvania

Use only Reading 5-Point Nipples with Reading 5-Point Pipe . . . you'll know them by the indented spiral band.

For Your Protection, This Indented Spiral Forever Marks All

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THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering
ARMOUR INSTITUTE OF TECHNOLOGY

VOLUME XXII JANUARY, 1931 NUMBER 2

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Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.

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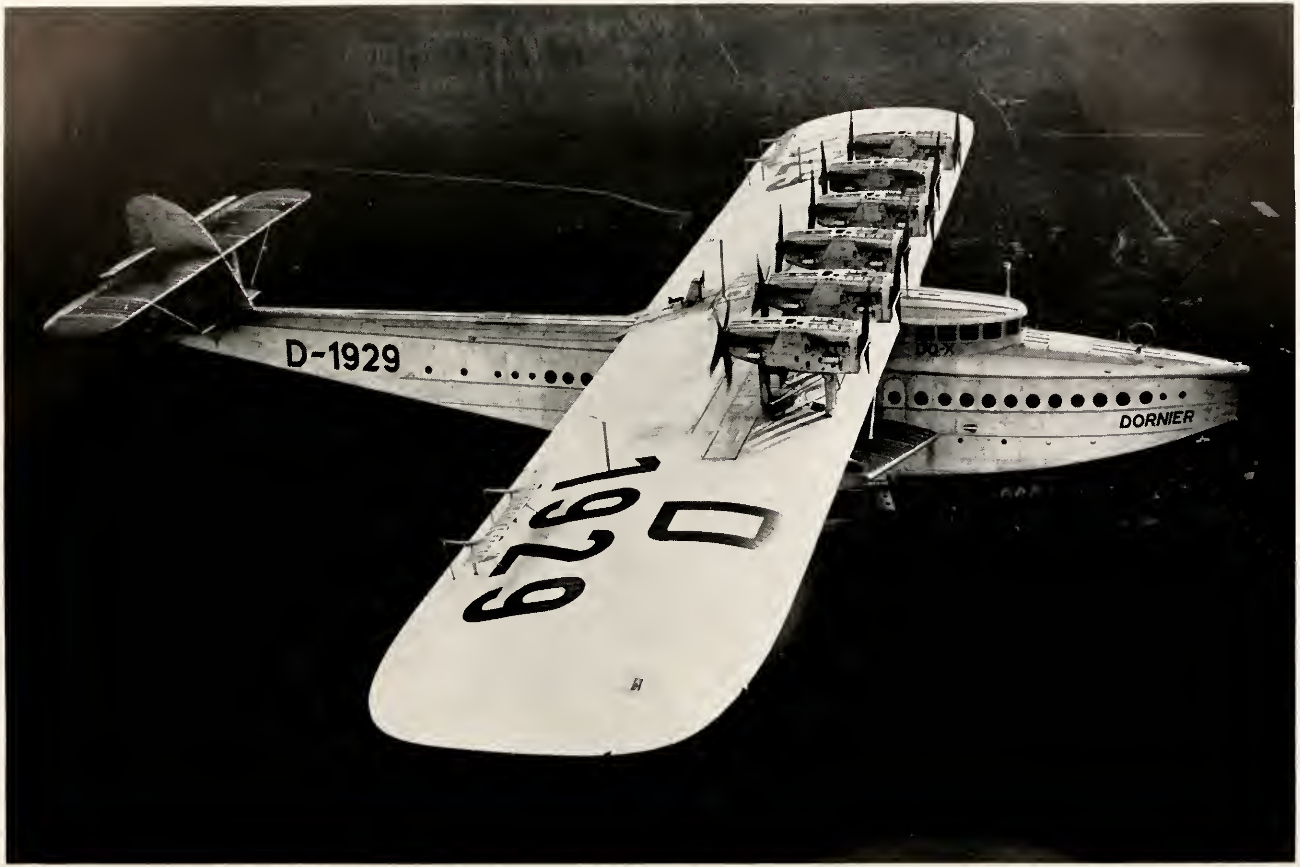


A View of the Do-X—the Largest Airplane Ever Built

The
ARMOUR ENGINEER

VOLUME XXII. JANUARY, 1931 NUMBER 2

The Lindbergh Beacon

By **R. M. Krause, '31**

Student in the Department of Mechanical Engineering

OUT of the pioneering of the Wright Brothers sprang a new industry. Aviation has grown in leaps and bounds to a tremendous size in its few years of existence. But as with every piece of valuable work, caution must be exercised in its own method of destruction. Precautions are necessary for the industry's success and development. In aviation we must consider this ever important item under the term of reliability. Granting no consideration as to conditions, a question is asked: could a plane be depended upon to perform its duty when asked? At the outset of such work we would be very skeptical, but at the present time our answer would be favorable. Why? Because of the various necessitated precautions. Motors have been built for durability and steady running; the airplane has had its design improved to a very high degree through research work on stream line resistances. In keeping with this trend of success, beacons have held their own.

The engineer surmounted the obstacle of night flying by beacon development. At present, there are many such light threads peering into the night to aid the pilot These beacons are of a somewhat temporary structure as we consider those of the future. They are small in comparison and placed at short intervals. As a pioneer of the future the Lindbergh Beacon was constructed and put into operation.

Before we consider the object itself let us review some of the fundamentals of light. It appears that the limit of usefulness of the beacon is imposed only by the intensity of the light source, but there are laws governing the progressive diminution of light intensity over which man has no control, and they must be considered. These laws may be expressed as follows:

(a) The illumination falling on an object is proportional to the square of the distance.

(b) The illumination of the field, against which an object is seen, does not decrease proportionately as the distance.

(c) The contrast necessary for visibility increases very rapidly as the distance.

These three facts may be summed up in a law of decreasing returns, which is shown in a graph in Figure 1.

We can very readily see that very little is gained by a candlepower greater than one billion. The slight advantage obtained by the addition of the last 200 million candlepower is impractical, because of the great added weight and increasing dimensions of the beacon.

There are other limiting factors, of which two,—weather and curvature of the earth,—must be considered. The former may readily be dismissed by the fact that a heavy fog will cut off the sun; therefore a beacon light of sufficient intensity to penetrate all manner of fog conditions is out of the question. The curvature of the earth causes the beam to be deflected away from the earth. Light rays are propagated in straight lines; hence if a beam be directed at right angles to the radius of the earth (apparently parallel to the horizon), as we leave the source of light and travel along the surface of the earth, the elevation of the beam, with respect to the earth's surface, will progress quite

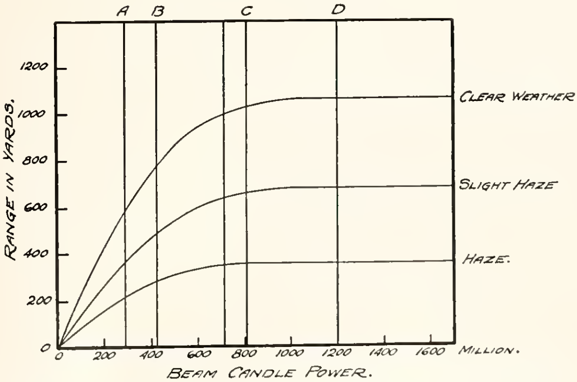
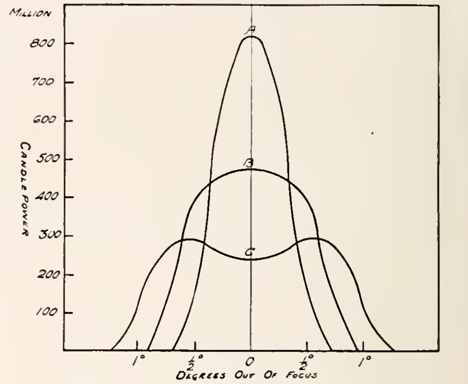


Fig. 1. This graph shows how the range of the beacon varies with the candlepower under three different weather conditions. It is seen that an increase in candlepower above one billion does not increase the range.

rapidly. At an elevation of 43,000 feet, the present airplane altitude record, a light source to be plainly visible to an aviator could not be more than 300 miles distant. For normal use of the beacon to an air-mail pilot flying at an average height of 3,000 feet, it would be visible to him at a distance of 100 miles. The former statement assumes that the aviator sees the light by looking down the beam. Beams projected far out into space with sufficient depth of light to render them visible when viewed at right angles or obliquely, for the present at least, seem impractical.

As the aviation beacon employs the greatest source of light so far produced by man, it will be interesting to consider the giant among these aerial lamps,—The Lindbergh Beacon. The beacon proper consists of a Sperry high intensity arc having a theoretical output of two billion beam candlepower which is mounted so as to make two complete revolutions each minute. An auxiliary light projecting a 36 inch beam of eleven million candlepower is mounted immediately below the beacon and fixed to point in the direction of the Municipal Airport. Airmen can readily pick up the flashing signal, and when over the beacon the fixed beam will guide them to a safe landing place.

The light intensity arc used in the main beacon is interesting, not only because of its tremendous light intensity, but further as an example of how man has approached the ultimate through a close study of nature. The arc and the sun are very closely related as to magnitude and mechanism. The sun has an intrinsic brilliancy of 950 candlepower per square millimeter while the arc has 800. The surface temperature of the sun is 6,000 degrees C., and the temperature of the high intensity arc is 5,500 degrees C.



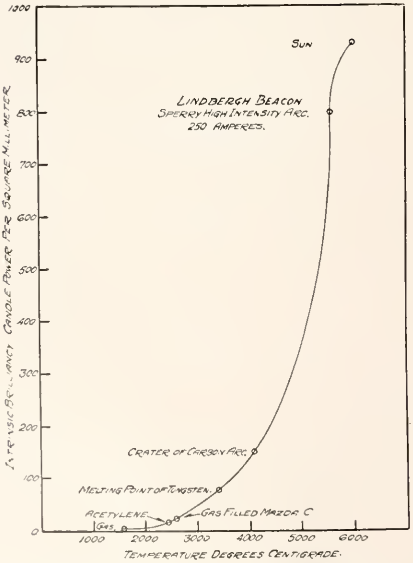
When the beam is out of focus there is a decrease in its candlepower. This graph shows that relationship for three different arcs.

The brilliancy of the Lindbergh Beacon may be illustrated by the fact that if the beam were thrown on a house or group of people fifteen miles away, photographs could be taken at that point. The beam also permits the reading of a newspaper 50 miles distant.

The intrinsic brilliancy of a light source is a function of its temperature. Carbon has the highest volatilizing temperature, about 3,000 degrees C. It yields a maximum light intensity of 160 candlepower per square millimeter. Raising the temperature beyond this point, by increasing the current passing through the arc, simply results in a more rapid consumption of carbon and not an increase in intrinsic brilliancy. Again, Mother Nature is the teacher. Since carbon is the solid that can obtain the highest possible degree of incandescence, a gas or liquid must be used. Now, the surface of the sun is gaseous, and its intrinsic brilliancy greatly exceeds that of carbon. From this, it is known that incandescent gases are capable of much higher intrinsic brilliances than incandescent solids, which may be explained by the fact that gases are translucent and light is derived from their depth as well as their surface. This phenomenon is used in the high intensity arc employed in the Lindbergh Beacon. An incandescent ball of vapor forms the light source and is derived from the rare earth's cerium and lanthanum which are incorporated as a relatively soft core in the positive carbon of the lamp. When a high current density is forced through the carbon, the earths are volatilized and projected into a crater formed at the tip of the carbon. For reasons of focus, it is necessary to confine this ball of incandescent vapor in a very small area. This is accomplished through the action of the negative carbon which is so arranged that its flame sweeps across and impinges on the vapor, thus compressing it and confining it in the crater of the positive carbon. When a current of 250 amperes is forced through the arc it gives out an intrinsic brilliancy of 800 candlepower per square millimeter. Increasing the current beyond this value produces such a compressed ball of vapor as to render it opaque, thus shutting out light from the depth and reducing the emitted brilliancy.

No less important than the light source is the reflector that forms it into a beam. The beam candlepower is governed by the size of the reflector. The light rays are gathered up from an area and reflected into a single beam, and since the light source is an area, the beam has a spread. The beam candlepower is proportional to the area of the reflector, but a limit is reached, for the increase in beam candlepower is gained at the expense of the size of the beam. The larger the mirror, the smaller the beam. Practice has established the most effective combination to be a

(*Continued on page* 72)



This figure shows the intrinsic brilliancies and temperatures produced by several of the more common illuminants. It shows how far above the others and how close to the sun the arc of the Lindbergh Beacon ranks.

Aircraft Engines

By **Daniel Roesch, '04**

Professor of Automotive Engineering

THE following comments and compilations have been prepared with a view of presenting some of the outstanding engineering, practical, and commercial features of aviation engines. Reference is necessarily made to the vehicle in a number of instances and also to fundamentals which are important, even though they are not necessarily late developments. The material is obviously abridged and many important items omitted entirely. The abridgment is illustrated in the Table of Engines where less than half of the available engines are tabulated. In the United States there are many satisfactory power plants which are not listed. The subject of fuels and other important phases are worthy of considerably more attention than is given to them.

From the figures of Mr. Walter W. Wright, Chicago's Director of Parks, Playgrounds, and Aviation, there were for the first nine months of 1930, 62,809 passengers carried in and out of Chicago on scheduled air routes as compared to 34,190 for a like period in 1929. The Municipal Airport had 23,515 landings and take-offs for 1930 and 44,104 for 1929, the decrease being explained by the discontinuance of student flying activities at this airport. The mail poundages were respectively 2,035,881 and 1,197,248.

The following Air Traffic Facts from the Stearman Aircraft "Contact" indicates the magnitude of aircraft activities:

Boeing Air Transport flew 2,780,00 in 1929.

Air Mail pilots flew 15,695,000 miles with 7,000,000 lbs. of mail in 1929.

9,400 licensed pilots are listed.

Regular Air Transportation totals 90,000 miles per day.

Forty tons of gold bullion were transported across the English Channel from London to Paris in 9 days.

The airship hangar of the Goodyear-Zeppelin Co. at Akron is so large, that snow, rain, or a windstorm is possible inside with a perfect day outside.

The highest altitude ever reached by man was attained by Lieut. Apollo Soucek, Naval flyer, when he climbed 43,166 feet, more than eight miles.

The largest wind tunnel in the world and a covered body of water nearly half a mile long to serve as seaplane testing basin are near completion at the Langley Memorial Aeronautical Laboratory of the National Advisory Committee on Aeronautics, Langley Field, Va.

Captain Frank M. Hawks took just 12 hours, 25 minutes, 3 seconds to cross the continent from Los Angeles to Valley Stream, Long Island, setting a new record; the time included three stops of 15 minutes each.

Taking advantage of the new law permitting passengers on mail planes, the National Air Transport on December 1, 1930, inaugurated the first Chicago to New York direct passenger service with a scheduled time of 6 hours, 34 minutes, eastbound, and 8 hours westbound, for the 730 mile flight. New tri-motored Ford Transports with a high speed of 152 M.P.H. and 125 M.P.H. cruising speed are used. The speed improvements have been made possible by better streamlining of motors, landing gear, and a general "cleaning up." Eight passengers and 1,000 pounds of mail can be carried. This service illustrates the increased reliability of the modern aircraft engine and the refining of many factors in personnel, communication, and air travel comfort.

An estimate based on the Department of Commerce licenses, identifications, and reports indicates that there were 2,154 airplanes manufactured for civil use in the first nine months of 1930 with an additional

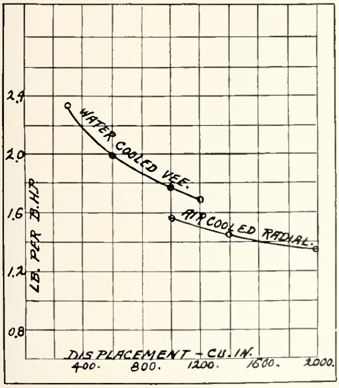


Fig. 1. This graph shows the relation between weight per horsepower and total piston displacement (American) for both the water cooled vee and the air cooled radial engines.

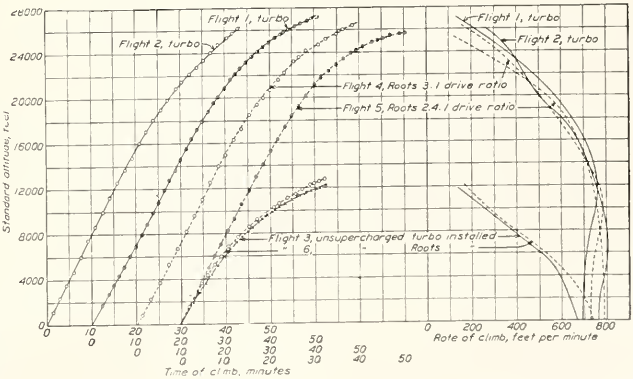


Fig. 2. This shows the climb performance of a DH-4M2 engine with the turbosupercharger and with the Roots type supercharger for two drive gear ratios; also unsupercharged with a supercharger installed.

556 military aircraft. 198 airplanes were exported. These planes were made by 296 companies with 38 of the companies making more than 10 aircraft and accounting for 81 per cent of the total.

Examples of proposed airplanes are given in N. A. C. A. Technical Memorandum No. 463, from "Prospective Development of Giant Airplanes" by B. Von Romer in Luftfahrt, October 22, 1927. The discussion includes a description of Professor Junker's J-1000 airplane embodying four 3,000 H. P. engines with a wing span of 230 feet and accommodations for 100 passengers. The Rumpler trans-ocean seaplane project was an all-metal monoplane of 308 feet span and 129 feet length. Ten 1,000 H. P. engines furnish the power. The wings are large enough to permit living rooms being built in them. Dr. Grulich's seaplane also had ten 1,000 H. P. engines with a wing span of 377 feet. The R. Klant seaplane project had five 3,000 H. P. engines and was of the all-metal cantilever monoplane type with a span of 459 feet. The estimated cost was $1,800,000 and the speed was estimated at 165 miles per hour. Provisions were made for 150 passengers, 35 members of the crew, and a fuel load of about 80 tons.

The first Wright Bros. plane was powered with a four cylinder 28 horsepower engine weighing about 400 pounds. The layout was designed with a chain drive from the engine at 1,400 r.p.m. to two propellors each operating at 800 r.p.m. The early Curtiss plane was powered with an 80 horsepower eight cylinder Vee water-cooled engine weighing about 550 pounds. The earlier Anzani engine of two cylinders developed 35 horsepower and weighed 165 pounds. These pioneers were followed by the higher power revolving-cylinder radials as exemplified in the Gnome. These were all air cooled and at the time were a great step forward in weight per horsepower. They have been made in the seven and nine cylinder single-bank and in the fourteen and eighteen cylinder double-bank having staggered cylinders. The single-bank has a single throw crank shaft which is stationary, usually with the crank pin at the highest position. A master connecting rod with eight articulated rods connect the pistons to the crank pin and are similar to the modern rod for static radial engines. The cylinders are mounted on a crank case which is free to revolve due to the side-wall reaction forces of the pistons. The crank case is mounted on ball bearings and has an extension for propeller mounting.

The construction gives a large flywheel effect and considerable gyroscopic effects. The earlier engines had a valve in the piston which was operated by the rocking action of the connecting rod. It controlled the flow of rich mixture from the crank case to the combustion chamber. A large valve in the cylinder head served as exhaust and also as an air inlet valve. Later models dispensed with the troublesome valve in the piston and substituted ports in the cylinder walls. The one valve engines are known as Monosoupape Engines and all operate on a four stroke modified Otto cycle. One of these engines is in the Automotive Laboratories of the Armour Institute of Technology. It has nine cylinders developing about 110 horsepower at 1,300 r.p.m. Its weight is 265 pounds. The centrifugal force on materials and gas mixtures have important effects in this engine. Ample relative air speed for cylinder cooling is obtained during operation although the design did not include control

TABLE NO. 1

AIRCRAFT ENGINES *
(Abstracted)

Maker	Name	Type	Bore and Stroke	No Cyl	HP	RPM	Cooling	Cylinder Arrgt	Comp Ratio	Wt Lb.	Remarks A-Army N-Navy
			AMERICAN ENGINES								
Allison	X 4520		575x726	24	1200	1800	A	X	510	2890	Supercharged (A)
	Mod Lib	V 1650	500x7.00	12	420	1700	W	45 Vee	542	905	(A)
		V 1410	4625x700	12	410	1800	A	45 Vee	6.37	1010	(A)
Curtiss	D 12 D		450x600	12	435	2300	W	60 Vee	530	680	(A)(N)
	Conqueror	V 1570	5.125x626	12	600	2400	W	60 Vee	580	760	(A)
	Chieftan	H 1640	5625x650	12	600	2300	A	Radial	540	-	(A)(N)
	Challenger	R 600	5126x4836	6	170	1700	A	Radial	533	420	(A)(N)
Cirrus	American		4331x5118	4	90	1900	A	Line	5.00	265	
Packard		Diesel	48125x6.00	9	225	1950	A	Radial		510	Fuel 040 lb Cruising
Motor		3A-1500	5375x5800	12	500	2000	W	60 Vee	6.00	807	Direct & Inverted (A)(N)
Car		4A-2500	6375x650	12	770	2000	W	60 Vee	57	1255	(A)(N)
Co		1A-2775	5375x600	24	1350	2700	W	x	68	1480	(N)
Pratt &	Wasp	R 1340 B	575x575	9	425	2100	A	Radial	525	672	(A)(N)
Whitney	Hornet	R 1690	6125x6375	9	500	1900	A	Radial	5.00	770	(A)(N)
Roberts					135	1800	W	Line			Two Cycle
Wright	Whirlwind	R 790 A	4500x5500	9	225	1800	A	Radial	54	530	(A)(N)
	J 6	R 975 E	5000x5500	9	300	2000	A	Radial	54	535	(A)(N)
	J 6	R 540	5000x5600	5	160	1800	A	Radial	54	380	(A)(N)
	J 6	R 760	5000x5600	7	225	2000	A	Radial	54	440	(A)(N)
Wright	Cyclone	R 1750	6000x6875	9	525	1900	A	Radial	51	785	Less Hub
	—	V 1460	4875x6600	12	525	2300	A	60 Vee	53	925	Experimental
	Gypsy		4500x5062	4	90	1900	A	Line	60	265	
			ENGLISH ENGINES								
ABC	Scorpion	Mark II	4016x3600	2	34	2800	A	Opposed	60	111	39 at 2600
A.D.C.	Cirrus	Mark I	4134x5118	4	60	1800	A	Line	46	265	
	Gypsy		4500x6062	4	90	1900	A	Line	50	285	
	Nimbus		5984x7480	6	305	1450	W	Line	54	675	
Armstrong	Jaguar	IV a	5.000x5800	14	385	1700	A	Radial	5.0	810	
	Leopard		6000x7500	14	700	1500	A	Radial	50	1416	
Beardmore	Simoon	Mark I	8625x8968	8	1100	1250	W	Line		2770	Inverted
	Tornado	Diesel	8425x1200	8	1200	1350	W	Line		2350	
Bristol	Cherub	III	3543x3800	2	33	2900	A	Opposed	55	95	
	Jupiter	VI a	5750x7500	9	416	1700	A	Radial	63	720	455 at 5000 Ft
	Mercury	Series I	5760x6500	9	800	3500	A	Radial	86	680	Racing Supercharger
Napier	Lion	VII a	5500x5126	12	875	3300	W	W	10.0	850	Racing
Rolls Royce	Condor	III Direct	5600x7600	12	665	1900	W	60 Vee	53	1213	
			FRENCH ENGINES								
Anzani		3A	4134x4724	3	35	1700	A	Radial	46	132	
Farman	Geared	18 WD	4331x4921	18	600	2800	W	60 W	55	873	730 at 3400
Hispano		8AB	4724x5118	8	180	1800	W	90 Vee	53	420	236 at 2000
		12 MB	5118x6693	12	500	2000	W	60 Vee	6.0	882	580 at 2100
Hispano		12 LB	5512x6693	12	650	2000	W	60 Vee	60	926	668 at 2100
Lorraine	Dietrich	14 AC	5316x5906	14	470	1800	A	Radial	5.0	970	
		18 Ka	4724x7087	18	650	1850	W	40° W	60	1220	690 at 1850
Panhard	Levasseur	VK 122	5.512x6693	12	450	1500	W	60° Vee	54	1102	525-1800 Knight
Renault		12 Mc	6299x7087	12	700	1700	W	60° Vee	58	1300	
Salmson		6 AD	2756x3386	6	26	1900	A	Radial	56	132	
		18 AB	4921x6693	18	500	1700	A	Radial	54	1012	
			GERMAN ENGINES								
BMW		IV	6299x7480	6	250	1440	W	Line		671	310 at 1500
		VII a	6299x7480	12	600	1620	W	60 Vee	73	1155	770 at 1650
	Hornet	Direct	6126x6875	9	525	1900	A	Radial	50	770	
Junkers		L 8	6299x7480	6	350	1800	W	Line	55	880	
	Diesel	F 03		5	700		W	Line	136	1760	Opposed Pistons
Maybach		VL II	5512x7087	12	550	1600	W	60° Vee	61	2316	
Mercedes	Benz	F 2	6495x8268	12	800	1500	W	60 Vee	60	1654	1000 at 1700 Supercharged
Siemens	Halske	SH 20	6063x7402	9	560	1800	A	Radial	53	905	1930 Production
			ITALIAN ENGINES & OTHERS								
[illegible]		R 1	5000x7060	12	400	1750	W	60 Vee	54	887	Russian (Liberty)
Fiat		A 20	4628x5906	12	415	2200	W	60 Vee	57	722	455 at 2400
		AS III	5708x6890	12	1050	2500	W	60 Vee	65	904	
Isotta		80 T	3437x5512	6	80	1400	A	Line	50	242	
		1000	5906x7087	18	900	1600	W	60 W	50	1770	1000 at 1650

* From NACA Technical Notes No 303 TR

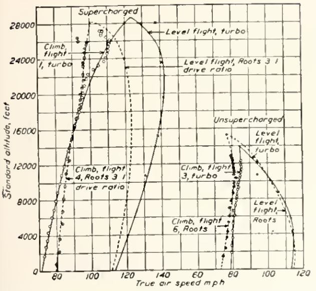


Fig. 3. Here is shown the air speed in climb and level flight with the turbosupercharger and with the Roots type supercharger using a 3 to 1 drive reduction gear; also unsupercharged but with a supercharger installed.

for uniform cooling of the entering and leaving side of the cylinders. The out-of-round result to the cylinder was partially taken care of by a copper or other special flexible piston-ring in the top slot. These were termed obdurator rings.

The demand for increasing powers and lower weights developed the French Hispano-Suiza water-cooled Vee type which was built in sizes from 80 to 300 horsepower and weights about three pounds per horsepower. This engine was later built in the United States by the Wright Company in various sizes, and is still manufactured in improved types and larger sizes by foreign builders. The advent of the war with competition for air supremacy demanded larger powers as illustrated by the experience with the Liberty engine, designed and built in the U. S. with the war experience of other engines as a criterion. The original layout called for an eight cylinder 5 x 7 power plant but before these were produced, the change was made to 12 cylinders of the same bore and stroke. Many of these water-cooled Vee type engines were built. The power was from 300 to 400 or more horsepower and the weight about 850 pounds. These have been operated up to 2,100 r.p.m. and proved to be a valuable asset and notable advance although relatively short lived in the light of modern engines. The Curtiss OX 4 x 5 eight cylinder water-cooled Vee is also of this vintage and has been extensively used. It developed 90 horsepower at 1,450 r.p.m. and weighed about 400 pounds. Many other foreign engines were developed at this time, among which may be mentioned the Rolls Royce, Sunbeam, Mercedes, Daimler, Maybeck, Renault, LeRhone, Salmson, Anzani, Isotta-Franchini, Fiat, and many others.

A landmark in aviation was established in 1926 when Col. Lindbergh made his non-stop flight across the Atlantic. This occurred during a great engine development period which is still in the ascendency as evidenced by more recent endurance and speed records being made in rapid succession. Col. Lindbergh used the Wright Whirlwind Model J-5 9-cylinder static-radial engine of 225 H. P. and weighing 530 pounds.

Other outstanding American engines include the Pratt and Whitney Wasp (425 H. P. at 2,100 r.p.m. weighing 670 lbs.) and the Hornet (525 H. P. at 1,900 r.p.m. weighing 770 lbs.); the Packard Motor Car Co. types 3A-1,500 G (600 H. P. at 2,500 r.p.m. weighing 915 lbs.), 4-A—2,500 G (880 H. P. at 2,700 r.p.m. weighing 1,640 lbs.), and 1-A—2,775 (1,350 H. P. at 2,700 r.p.m. and weighing 1,450 lbs.); the Curtiss Challenger (180 R. P. at 1,900 r.p.m. and weighing 420 lbs.); the Conqueror (600 H. P. at 2,400 r.p.m. and weighing 870 lbs.), and many others. A number of these engines have been selected from N. A. C. A. Technical Note No. 303 and are included in Table No. 1, together with certain specifications for reference. These indicate the diversified nature of the power demand. A wide range of speed for rated power is noted and there are some apparent variations in the specific power ratings due to permissible variations in engine compression ratios, supercharging, and speed.

Many new ideas in engine design are in the development stage, some of these requiring only better materials to make them practical. The two cycle is included in many projects, as are the Diesel or Compression ignition engine and the manifold fuel injection engine which are in vigorous development. The Packard Diesel has progressed to considerable service use with its practicability vouched for by an Approved Type Certificate. The Pratt and Whitney Company have engines handling the equivalent of fuel oil in other than compression ignition design, and the General Motors Corporation is evidently seriously considering the Diesel by its recent action in acquiring The Winton Co. The reduced fire hazard, while using the less volatile fuels that are suitable for the Diesel engine, is illustrated by the apparent determining factor against gasoline engines in the case of gas-electric drives for trains. Large fuel supplies necessary for heavy trains present serious potential wreck hazards.

Two late aircraft engines by the Wright Aeronautical Corp., Paterson, N. J., are the Cyclone Models R-1750-E and R-1820-E. These are nine cylinder air-cooled radial engines with improved power and cylinder head cooling. The R-1750-E is the 1929 Cyclone improved, and the R-1850-E is the largest of the Cyclone line. It has a Department of Commerce approved rating of 575 H. P. at 1,900 r.p.m. and a dry weight of 865 lbs. Its weight per H. P. is slightly over one-half of the Whirlwind Engine used by Lindbergh in the Atlantic flight. Refinements and large bore have permitted reduction from 2.18 square inches of cooling area per cubic inch of the Lindbergh Whirlwind Engine to 65 per cent of this for the new Cyclone with an accompanying reduction in head temperatures. The improved design has lowered the maximum cylinder head temperature from approximately 575 degrees Fahr. to 375 degrees

(*Continued on page* 69)

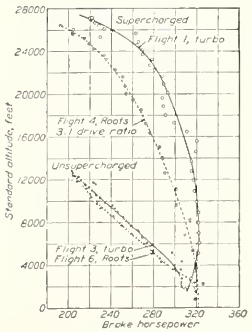


Fig. 4. This graph shows the power delivered to the propellor in climb, with the turbosupercharger and the Roots' type supercharger using a 3 to 1 drive gear ratio; also unsupercharged but with a supercharger installed.

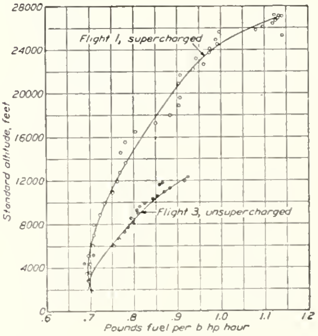
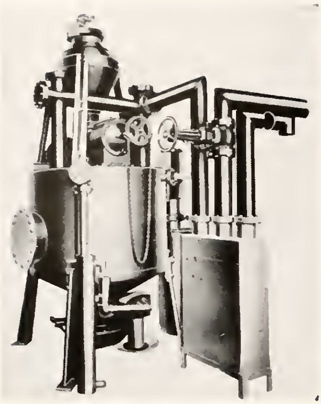


Fig. 5. This figure represents the fuel consumption during full-throttle climb using the turbosupercharger; also unsupercharged but with the supercharger installed.



An Acetylene Generator

The Production of Acetylene for Commercial Use

By **C. J. Stempkowski, '33**

Student in the Department Of Chemical Engineering

THE widespread use of acetylene, prompted through the oxy-acetylene process of welding and cutting, has to-day become a factor of economic importance to industry in all of its branches. Its discovery in 1836 by Demond E. Davy of Dublin was unheralded, for its commercial possibilities were unforseen and termed somewhat obscure.

A half century elapsed and chemists confined the preparation of acetylene to experiments in which carbides of potassium and other expensive compounds were used in its making. In 1892 Professor H. Moissan and Thomas L. Willson, a Canadian, discovered that lime and carbon could be made to combine in an electric furnace to produce a carbide that would yield acetylene at a low cost. That discovery marked its inception to the commercial world as an illuminant. Its uses and applications rapidly increased, propagating with the advent of the blow torch.

Acetylene welding and cutting have now assumed an important position in the structural steel, aircraft, and shipbuilding industries. The task of scrapping battleships, freight cars, and twisted steel framing resulting from fires and storms has been immensely simplified through the use of the blow torch. In industries where steel plate construction is effected, welded joints are gradually becoming more popular and are supplanting the steam hammer riveting methods. Only recently Germany set a large ocean liner afloat that was entirely assembled by welded joints.

Acetylene when used in the field is compressed in portable cylinders, that may be moved about from job to job. The operations by which the acetylene is manufactured and stored in these cylinders will be described here.

Acetylene, which is represented by the formula C_2H_2, is when pure, a colorless gas, having a garlic-like odor. It burns with a brilliant blue flame. Mixtures of acetylene and air, varying in the proportions from 3 to 82 per cent by volume, explode at 480°C. The gas decomposes with explosive violence when heated to about 780°C. It has a specific gravity of .9056, a boiling point of −81°C, and a freezing point of −85°C.

Today, commercial acetylene may be generated and compressed without much supervision or risk. The thorough understanding of the properties and chemical behavior of the gas has enabled manufacturers to produce gas equipment which guards against every minor detail dealing with the safety of the manufacturing plant.

The appliances included in an acetylene plant are the generators, the compressors, the gas holder, the purifying and drying system, and the cylinders. The generator is the chamber in which the reaction of calcium carbide and water takes place to produce acetylene as represented by the chemical reaction: $CaC_2 + 2H_2O = C_2H_2 + Ca(OH)^2$

The gas holder serves as the storage tank for the un-compressed gas. The purifying system is used to cleanse the acetylene of all contaminating ingredients, the chief of which is hydrogen phosphide. The compressors serve to pump the acetylene into the cylinders, preparing the gas for commercial use.

The generation of acetylene from calcium carbide is one of the simplest tasks in chemistry, yet the commercial plan calls for mechanical contrivances which are somewhat complex. All plants producing acetylene for commercial purposes use the carbide to water type of generator. The method of generating gas in this type of generator provides for the introduction of carbide from an upper chamber to water that is stored in a lower chamber, known as the shell. Another common type of an acetylene generator, but one that is not used generally, is the water to carbide type, in which the water is fed onto the carbide.

The carbide chamber in a carbide to water generator is a frustum shaped container, designed to hold several hundred pounds of carbide. At the upper end of the frustum is an opening through which the carbide is introduced when a supply of acetyelne is to be made. The lower end of the frustum leads to a screw box, where an auger screw revolves and feeds the carbide from the hopper to the water. The screw revolves at a rate of speed so regulated that a definite quantity of carbide is permitted to pass through per unit time. This arrangement of adding the carbide to water results in a consistency of gas evolution that prevents uncontrollable rises in temperature and pressure, as would be the case if the carbide were permitted to come in contact with water in irregular quantities.

One of the main safety factors of acetylene generation is to safeguard against high temperatures, which will invariably result in high pressures being produced. When one gram-molecule of acetylene burns in oxygen, 313.8 calories are set free. The heat produced when the same amount of carbon and hydrogen, in the free state, are burned is 262.3 calories. Acetylene is, accordingly, an endothermic compound; its heat of formation is —51.5 calories. This storing-up of energy in the molecule leads to the instability and reactivity which is characteristic of acetylene.

Acetylene is subjected to disintegration when brought up to a temperature of 780°C. The equation representing its decomposition with the evolution of heat is as follows: $C_2H_2 = 2C + H_2 + 49{,}300$ calories. The stability of undissolved acetylene becomes doubtful at pressures exceeding one atmosphere. For this reason the water supply in a generator is usually arranged so that there is about one gallon of water to every pound of carbide before the generation takes place, and an additional half gallon to the pound is added while the generation is in process. Most of the modern generators are equipped with automatic water feed valves and automatic relief valves which permit acetylene to escape from the generator when the pressure exceeds a certain point.

The generating chamber on the apparatus is a cylindrical vessel. If the carbide hopper has a capacity of 1000 pounds, the water container holds about an equal number of gallons of water. Evolution of the gas takes place immediately after the carbide comes in contact with the water. The gas is permitted to escape through a pipe which leads out of the top of the generating chamber and is carried downward to the lower level of the chamber, where it leads into another container called the washer. The washer is a closed-in receptacle, which like the generating chamber, is kept full of cool water. Its purpose is to wash, purify, and cool the gas as it passes through the system from the generator to the gas holder.

Impurities found in acetylene are usually traceable to impure carbide. The three common impurities, the presence of which are detrimental to the efficiency of the gas, as well as the safety of the plant, are ammonia, hydrogen sulfide, and hydrogen phosphide. Since ammonia is highly soluble in water, forming ammonium hydroxide in the reaction, it is entirely extracted from the acetylene as the latter passes through the water in the washer. The washer further serves to extract nearly all of the hydrogen sulfide; whatever portion remains in contact with the acetylene is removed in the purifying system. It is almost inexcusable to permit hydrogen sulfide to pass out of the generator as it is quite a simple problem to remove it.

The percentage of hydrogen sulfide in a volume of acetylene is in the neighborhood of .17%. Since one volume of water dissolves 4.37 parts of hydrogen sulfide at O°C. and about 1.5 volumes at the maximum permitted temperature at which a generator runs, all of the impurity can be removed by washing. Care must be taken to prevent the water in the washer rising to a boiling temperature for at that point it loses its properties as a solvent for hydrogen sulfide. On the other hand, it is not good practice to keep the water in the washer at low temperatures due to the fact that the solubility of acetylene is highly increased in cool water. At O°C., 1.79 cubic feet will dissolve in 10 gallons of water; at 10°C. its solubility is decreased to .49 cubic feet; while at 70°C. only .25 cubic feet will dissolve. Tests have shown that the best results are obtained when the temperature of the water in the washer is about 65°C. or slightly less, for then efficiency and safety are in balance.

Every generator, besides being equipped with the carbide hopper, water gauges, and washer is also equipped with thermometers, manometers, an automatic inlet gas valve, and a safety seal. The thermometers serve to register the temperature within the generating chamber. As stated before, the maximum temperature permitted is in the neighborhood of 65°C. At this point it is quite safe to assume that the acetylene will not polymerize, decompose, or become weakened in its calorific value. The temperature of 65°C. is 415° below the ignition temperature, 715° below the temperature of disintegration, and 245° below the temperature at which hydrogen sulfide dissociates. During the operation it is not a difficult task to maintain a temperature of 65°C., for it will not require the persistent addition of water. Too much water will not affect the safety of the generator, but it hinders the efficiency of the generator. If cold water is permitted to flow at too great a speed, much of the unattached carbide will be forced out of the overflow pipe in the slaked lime outlet; consequently the gas yield will be noticeably diminished.

The safety seal serves to insure the system against developing excessive pressures. The pressure in a generator is usually kept at one-half atmosphere or less, registration of which is made by means of the manometer. The seal consists of a pipe that is tapped at the upper end of the generator proper and leads to a cylinder partly filled with water. If the pressure in the generating chamber exceeds one-half at-

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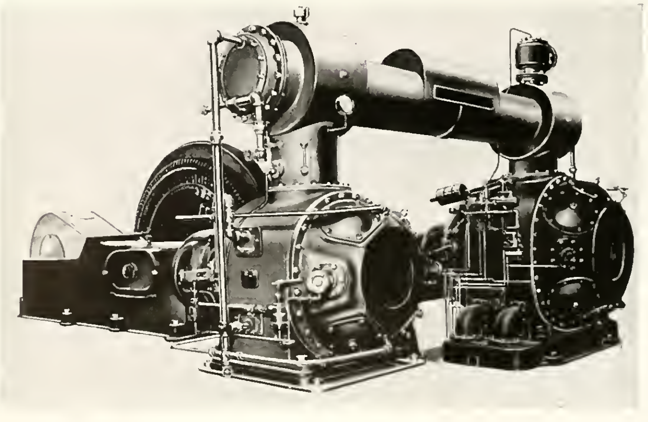


A compressor of the type pictured above is used to compress the acetylene to the high pressure desired in the charged cylinders.

An Observation of Conditions in Liberia

***By* R. C. Peacock, x-'27**

Civil Engineer for the Firestone Rubber Co.

THE faint gray streaks of dawn have appeared over the tops of the coffee trees on a nearby hill, and the thatched white mud houses of the tiny African villages have aroused themselves for another day. Thin white wreaths of smoke issue from the conical roofs as the women and children prepare the morning meal of rice or cassava and fish. Their glistening black bodies are entirely devoid of clothing with the exception of a woman here and there who wears a loin cloth of beads and bright colored cotton material. The men lounge about smoking and discussing the anticipated activities of the day. Some of them wear the blue and white robes of "country cloth" woven by their women and the chief wears a long white flowing gown upon which queer designs are embroidered.

They have finished "chop" and are ready to go about the day's work when suddenly a terrified youth bursts in from one of the jungle trails chattering excitedly in the queer monkey-like dialect of the West Coast negro. The women suddenly herd the children into the houses as a motley file of armed men march into the compound. They are dressed in blue woolen shorts and skirts, khaki leggings, and black tasseled red fez. They are barefooted and carry rifles of every conceivable ancient make. They are a detachment of the Liberian frontier force sent by the District Commissioner to "recruit" laborers for the Spanish plantations on Fernando Po.

Their officer, who has been riding in a hammock carried by four enormous blacks, seats himself in the palaver house and summons the chief. After an hour's heated discussion, the chief is overcome by his fear of the government troops and agrees to the wishes of the messenger. He musters the men of the village and tells them that "D. C." has again sent for workers to go down the coast. There is an immediate uproar and wailing from the houses of the women whose men have been selected to go. They gather their few belongings together and make them into long packs tied with palm fronds. These they place upon their backs with a supporting strap around the forehead. As they enter the trail escorted by the soldiers they turn for a last dejected look at their homes where the huge drums are throbbing with melancholy beats and sending the news on to neighboring villages who, in turn, will be forced to give up their quota of men to the Liberian officer riding languidly in his hammock among his handful of incompetent soldiers whose rusty rifles are sufficient to hold thousands of natives in awed subjection.

Scenes similar to that described above have taken place time after time in the country of Liberia on the west coast of Africa. They are not unusual occurrences at all, but on the other hand, have become to be periodical events, looked upon with dread and fear by the natives. During my stay in Africa, during which time I was occupied with the problem of constructing roads through the wilderness there, it was my lot to witness many such pictures of sorrow. I have seen the natives of Liberia taken from their homes in the hinterland and shipped as slaves to the Spanish island of Fernando Po many hundreds of miles down the African coast. I have seen some of them return after several years and I have seen others go who have never returned. These conditions in themselves would not, perhaps, arouse any considerable comment were it not for the fact that the Republic of Liberia was originally started by the American Colonization Society solely for the purpose of providing a haven for slaves who were freed in the United States as a result of the Civil War. They were given a section of land between British Sierra Leone and the French Ivory Coast. Their government was organized and supervised by Americans and was

This view shows the type of shelter that the natives of Liberia build to protect themselves against the hot African sun.

A typical Liberian village is shown here. Their manner of living and the kind of clothing worn by them may be gathered from this view.

patterned after our own system. This supervision and advice continued until they were deemed capable of self-government, at which time Liberia took her place as a republic among the nations of the world.

And now, some seventy years later, we find the executives of the country practicing the same unsavory trade from which they themselves were liberated many years ago at the cost to our own country of many thousands of men and millions of dollars. Was this cause justified? Some of us are beginning to wonder.

The Liberian negro is essentially a home-loving individual and unless he is confronted with unusual circumstances will never wander far from his own village. He has his family who cultivate his rice fields and tend his cattle and poultry. He has streams and forests in which he may fish and hunt. He has swamps thick with palms from which he extracts oil to exchange with traders for cloth and tobacco. Manual labor is foreign to his nature and entirely unnecessary to maintain his simple standard of living. He pays an exorbitant tax to his government and he is forced to do a certain amount of work on roads built from the coast to the interior. However, he does not complain as long as his domestic routine is not broken.

We who have worked with these natives have found them, on the whole, a friendly, easy-going folk who, at times, actually become industrious if they are treated justly. To us, then, it is real tragedy to see them taken from their homes and separated from their wives and families, possibly never to return.

The government officials of the two countries involved attempt to avoid the stigma of the term "slavery" by paying the natives a wage for their work. But this wage must be spent by the native to live on the strange island to which he is sent and any remaining money must be paid to the customs officials of his own country should he return home. His own government receives a definite fee per head for every man forced into this exile, so it is, after all, slavery exactly as it was practiced in the days of the "Middle Passage."

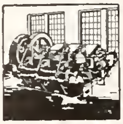
It is difficult for complacent America to realize that there, just a few days across the Atlantic, lies a country with a thin veneer of civilization along the coast. A country whose interior villages are ruled by the chiefs and devil doctors, whose men and women are children mentally. A country where strange religious rites are performed on little children and where disfigurement of faces and bodies is believed to add charm. Aside from all this, however, their moral standard is amazingly high, their villages are comparatively clean, and their day is not complete without a bath in some nearby stream. Neighboring tribes no longer quarrel and they may be found working side by side on the plantations and buildings of an American project now under way in Liberia. It is this rather admirable type of native, then, over whom we have placed the educated descendant of American slavery that he, in turn, may force them from their homes, thus gravely obstructing the development of his own country and making himself subject to the criticism of the world.

The modus operandi of securing boys and men for shipment to Fernando Po is quite simple. Liberia is divided into districts which are ruled by commissioners appointed by the President. The commissioners have at their disposal the native troops of the frontier force by means of which the village chiefs and tribal chiefs are kept in complete subjugation. The President simply has to notify his commissioners to have a certain number of natives ready for shipment on a certain day. The commissioner then apportions his quota among the chiefs in his district, and the chief forces the required number to go. They are escorted to the coast by troops and placed on ships from which many of them have their last glimpses of home and family. The head money is paid and goes into the pockets of a few individuals higher up in the government.

These shipments have been made constantly for several years, noticed only by those directly concerned. American firms who have sought to employ the native at a decent wage in his own country for the development of that country have been harassed by labor shortages and by the fear of the people to leave their own villages. As the financial condition of the country became more acute, the nefarious traffic increased until it finally came to the attention of the League of Nations and the outside world. The natives themselves are kept in absolute darkness as to the activities of the people of other countries. Privately owned radios are forbidden even though there are many men prosperous enough to be able to enjoy that educational medium. They had, therefore, no knowledge of how to lay their case before those who could deal with it. So it was not until some far-sighted resident

(*Continued on page* 73)

This group of natives formed one of the contingents of labor that had just arrived from the interior.



ENGINEERING NEWS

Ice From Mother Earth

It was considered quite a remarkable achievement when man learned to manufacture carbon dioxide ice, yet nature, in her quiet way, has been able to accomplish the same results. During the past two years an oil company in Northern Colorado has been operating an oil well that, along with the oil, gives off large volumes of carbon dioxide gas. The gas expands when it comes from the well and produces such low temperatures that the oil is frozen and appears as a snow. It is recovered when the temperature rises and the frozen carbon dioxide evaporates. Tests are now being run, and, if they are successful, the wells will be able to produce a trainload of dry ice per day.

Colorado is not the only place that is so unique. In Tampico another "mine" of carbon dioxide ice was discovered and the product, which is purer than that mentioned above, is already being imported to this country.

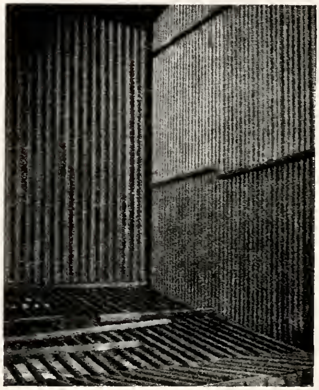
Nature, however, does not limit herself to the production of carbon dioxide ice only, because a natural ice well has just been found in South Dakota. This well is 172 feet underground, and "crystal clear" blocks of ice can be cut from it even in the hottest weather. It is located at a gypsum plaster plant near Rapid City. In digging for gypsum at the plant, workmen sunk a shaft at the end of which a large hole was excavated. The hole fills with water that freezes, which thus brings about a very cheap source for this natural refrigerant.

Meters in Chaldea

Astounding accuracy in the measurement of time was, according to record, achieved by the Chaldeans over 4,000 years ago. They used the principle of water discharged through an orifice in a jar as a measuring device in their astronomical work, and modern astronomers can find an inaccuracy of only 5 seconds in a period of 19 years. It is interesting to note that the man who buys a steam plow meter of today buys an ancient principle clothed in modern construction.

Water-Walls Used In Largest Steam Generating Units

An essential feature of the furnaces for the majority of large modern steam generating units is the water-wall construction. The generating station of a New York power company designed with three 800,000 pound steam generating units that are capable of evaporating over a million and a quarter pounds of water an hour, and many other successful water-wall installations, illustrate the feasibility of this design.



Water-cooled metal surfaces provided a complete lining in some of the large furnaces recently built in the east.

Water-lined furnace construction increases the capacity of the unit immensely, due to the more complete utilization of the radiant heat of the fire, but protection of refractories exposed to high temperatures was its original purpose. The desire for high rates of combustion to produce high evaporative capacities hastened the development of powdered coal firing, but the extreme temperatures which resulted with this equipment were sufficient to melt down and destroy the refractory lining of the furnace. A lining that could convey the heat away from the surface fast enough to prevent its destruction was essential to the success of powdered coal firing. Water circulated in protected or unprotected steel tubes interconnected with the main boiler system is such a lining as modern six-water wall installations have proved.

Power From Tropical Seas

The theoretical scientist has once again proved his mettle and has given the practical engineer something to think about. After two tremendously disheartening failures in laying out his plant equipment, and despite repeated discouragement from a number of fellow scientists, Doctor Georges Claude was able to demonstrate, conclusively, to the entire scientific world the practicability of an ingenius deduction from a theory of thermodynamics.

The project was carried out in a laboratory situated on Matanzas Bay, Cuba, which particular spot Dr. Claude had selected because of its adaptability to the experiment. The conditions required the availability of a supply of both warm and cold water, and he could obtain surface water from the Bay at a temperature of 80°F. and deep sea water at a temperature of 38° to 39°F. (at the time the actual test was performed there was a temperature difference of only 20°F.).

The theory of the experiment is comparatively simple. By drawing the warm surface water of the Bay into vacuum chambers, the water is made to boil and, hence, give off steam at a temperature considerably below the normal boiling point of 212°F. at atmospheric pressure. The steam obtained in this way then passes into and through turbines which operate electrical generators in accordance with all normal conditions. It then goes into a tank cooled by the colder water obtained from the Bay. Here it condenses, thus automatically creating the vacuum previously referred to. In order that there might be a continuous supply of outgoing energy, two vacuum tanks are used for generating steam, so that while one tank of steam is operating the turbine, the other is generating.

The difficult and most hazardous portion of the experiment was experienced in laying the huge pipe line that was to convey the cold water from the depths of the sea to the power plant. The first attempt to lay the pipe did not succeed because of inadequate means of getting it into the Bay, and in the second attempt, when success was within grasp, the pipe gave way and several hundred feet of it went down to the bottom of the sea. However, undaunted by these failures, Dr. Claude made another attempt a short time later, and after having painstakingly taken every precaution in procedure, he was rewarded with success. The pipe line was six feet in diameter, 5720 feet in length, and fabricated throughout its length. The sections were made watertight by both riveting and welding them. This great tube was built on a specially constructed track which extended back into the bay for a mile. Its strength and durability were amply tested, due to the fact that it had to be moved over a 10° horizontal curve and a comparatively steep vertical one.

When he was ready to perform the experiment, Dr. Claude started the pumps that carried the surface water to the vacuum tanks. A steam pressure soon built up, and the turbines attained a speed of several thousand revolutions per minute. The generator was then turned on, sending the energy to a battery of forty 500 watt electric bulbs. These lights began to glow and soon were very bright, thus climaxing the triumph of the inventor.

Plans are being made for the erection, sometime in the future, of a 25,000 kw. plant, and Dr. Claude estimates that the construction cost will be $60 per kilowatt, an amount that compares favorably with that of a modern fuel-burning steam-electric station.

New Speedy Trolley Cars Developed

Trolley cars so fast that automobiles will not be able to accelerate fast enough to "cut in" in front of them from a standing start are being obtained by the street railway company in Baltimore. Capable of acceleration on the controller at three miles per hour per second braking at the same rate, and with a free running speed of approximately 38 miles per hour at 550 volts, they will be about the fastest of any trolley cars operating in city streets. Each car, which weighs approximately 40,000 pounds, will have a front entrance, a center exit, and will seat 55 passengers.

May Change the Industrial Map

Volcanoes have been of little practical use to mankind. Awake, they are violent and incorrigible and do nothing but harm. Asleep and idle, they are endured, and men have been glad to let them lie. Yet to engineers it has long seemed a gross waste that the tremendous energy of these giants should not be harnessed and put to work.

Experimental work has already reached the commercial stage of production along this line. Northern Italy has been the principal site of this vast development, although parts of Bolivia and our own Yellowstone region have been investigated in regard to this work. The first mark of any importance was attached to the volcano when the glass factories of France and other large consumers of boric acid discovered this product in some of Northern Italy's "puffing holes." Though the method of separating the boric acid from the eruptive material was very crude, it rendered a locally obtained product that, formerly, had been imported.

This picture shows the pipe lines running along the site of a volcano and tapping the power from it.

This discovery led to the rapid increase of the supply of the commodity from this source. Engineers drilled artificial puffing holes and their efforts were rewarded. At present there are thousands and thousands of such wells in existence, and they have not diminished in the slightest degree the gases flowing from the natural holes. The wells are usually bored to a depth of 400 feet, and are lined with iron tubes eight to sixteen inches in diameter.

The steam and gases as they issue from these puffing holes are very impractical for power use, because of the impurities present. A water suited for turbine action is evaporated in large lead pans which are heated by means of the volcano's gases. There are many central stations throughout Italy's volcanic territory using turbo-generators for the production of their electricity. Many towns obtain their power and light from the same subterranean source. One puffing hole near Lardarello yields from 6,600 to 30,000 pounds of steam and gases per hour at a temperature of 356° F. Eleven average borings deliver power equal to that obtainable from the burning of ten tons of coal an hour.

Thus we have a source of energy more economical than waterfalls. With inexpensive power and plenty of it available, manufacturing industries will be established. It may be true that a whole new industrial concentration will, within the next decade, be found in the various localities due to a successful cutting in on the earth's own storehouse of power.

A Land Dam

Engineering is forever progressing by the amount of experimental research and pioneer work being done. The latter phase of this work has just been invaded by a feat in the form of a land dam.

The site selected for a power plant on the Saquenay river in Canada was in a gorge located on a rocky section of the river. In order to complete the large masonry dam across this gorge, it was necessary to excavate a diverting canal and turn the river at a time of low flow through this new channel while masonry foundations were extended across the original channel, which was the deepest part of the gorge. The usual method of putting in timber cribs and weighting them down with stones or large blocks of any heavy substance was not quite practical, due to the extreme depth and high velocity of the wa-

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THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

Vol. XXII **January, 1931** **Number 2**

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Make The Armour Engineer the best technical college publication in the country.

> *Every task we master adds to our reserve fund of strength and spiritual force. Every task that masters us depletes our spiritual force and decreases our strength of character.*
>
> —*Dorothy Quigley.*

RECENT INVESTIGATIONS by scientific men of the composition of the ocean's floor have brought forth the interesting fact that vast oil deposits may soon be uncovered. On the shoreline of California, along the swampy margin of Louisiana, and even under South American lakes, oil supplies of surprising magnitude are being brought to light. Here is a discovery of vast importance to the entire world; a triumph for the American engineer. What will be its consequences?

It is easy to recall the gloomy forebodings made in the past of the depletion of the world's oil resources and of the collapse of industries based upon the use of petroleum or its derivatives. It will be remembered how the economists raised their voices in tones bass and dismal, forecasting the rapidly approaching dearth of oil.

These predictions may have damped the ardor of constructional development involving utilization of petroleum. The effect of the new discovery in dispersing the clouds of uncertainty and doubt is a most desirable one. Another result, perhaps more direct, will be the effect on the price of oil. Increased supply, as ever, will lower the ultimate cost to the consumer and bring about a more widespread utilization of the mineral for fuel in power work, for commercial and domestic heating, and for hundreds of its other applications.

Hitherto, the rather high cost and the prospective inadequate supply have discouraged certain uses of petroleum, as for instance in domestic heating plants. It is natural to believe that a lowering in price will actually take place as the new resources are tapped. This new source may be the spring for the touch-and-go mechanism of consumption.

A third consequence may be forecasted in the form of an immediate stimulus to industrial activity by the oil companies and associated concerns which are to supply the necessary equipment. The present commercial depression is a most opportune time for such development.

THE RECENT ADDRESS of Dr. Allen D. Albert to Armour men on the occasion of the initiation banquet of the honorary fraternities was most inspiring. Momentarily suppressing his central theme, the Century of Progress Exposition, he vividly illustrated timely advice and words of counsel with interestingly related events of his remarkable life. Experience has proved, he said, that the burden is far greater after entrance into an honorary fraternity than before. The added responsibility of assuming the character of the fraternity must not be slighted. Nor should the greater expectations and more thorough scrutiny be ignored. A college career and life, richer and more enjoyable is the reward. Even then, after attaining success in the curriculum, in the fraternity, and the other phases of college life, the task ahead is fully twice as great. And we are reminded that success is invariably attained only after at least one failure or period of depression.

An important asset to everyone is

friendship, for it provides inspiration. The sphere of friendship that one forms about himself has a great effect on his actions and on the building of his character. Dr. Albert recalled the will power he was forced to exert that he might resist the influence of some of his acquaintances years ago, and cited the honorary fraternal groups as spheres of fine acquaintance where friendship may well be cultivated.

WITHIN THE NEXT FEW months, three of the world's greatest and most distinguished physicists will meet in Pasedena, California to conduct jointly several very important experiments. Dr. Albert Einstein, who is making his second visit to this country within three years, is probably the best known and most illustrious scientist and mathematician of the present day. He is to be one of the three. Professor Albert A. Michelson of the University of Chicago and Dr. Robert A. Millikan of the California Institute of Technology will be the other scientists present to carry on the research work. These latter two men and their achievements should not be overlooked in the light of Dr. Einstein's presence. Both of them have received the Nobel prize for their scientific work and have continued to strive continually for the further advancement of science, not only in their research but also in their teaching. Professor Michelson received the Nobel prize in 1907 for his work on the determination of the speed of light, while Dr. Robert Millikan received the Nobel prize in 1923 for his work on electrons.

These men have come together for the sole purpose of cooperation in the work on which all three have been experimenting in the past and which are all indirectly connected. Is this not a great array of scientifically inclined minds and of really great men? Not great in the sense that a statesman is great, not great in the sense that a conquerer is great, but great in the ideal and gainful work they have accomplished thus far in the conquest of the scientific field by man. Their names have already been immortalized in scientific annals, but not satisfied with resting on their present achievements, they continue to strive for greater precision on established theories and also for every possible new development. What has science to expect as the result of such an illustrious "huddle"? Will the accuracy of the determination of the speed of light be improved upon, or will Dr. Einstein come forth with another baffling theory?

What little of the work that is really understood may be summed up in the following brief account. Professor Michelson will first make an entirely new test on the speed of light in which he will use his now famous mile-long tube. Dr. Einstein then hopes to get the speed of light as accurately as possible from this experiment, so that he can go ahead with his theories. The speed of light, it seems, has a very important bearing on his theories of the curvature and the limitation of space. It was the early experiments of Professor Michelson and Morley in 1886 on "ether drift", which first gave Dr. Einstein his basis for the theory of relativity.

So as these three men and their aids set to work, the world sits back and marvels at their enterprizing and creative natures and at the same time eagerly awaits any new developments which they are almost sure to bring forth.

THE ACTUAL PREPARATIONS FOR THE WORLD'S FAIR to be held in Chicago in 1933 seem to be progressing rapidly. The men in charge of the Century of Progress are determined to keep this fair from falling in the category to which so many of the past expositions belong. And the members of that group were those that just couldn't be prepared at the scheduled time.

The Centennial Exposition held recently in Philadelphia doomed itself to mediocrity and disappointment by opening its gates to a show that was only semi-completed. Even the Columbian Exposition held in Chicago in 1893 was a whole year late in starting, for the original time planned for the event was 1892. It seems that in the case of these fairs too much was proposed in the time allowed for accomplishment. For the Century of Progress much too has been planned, but the work has been begun early and it is being done swiftly.

Be Strong

Be strong!
We are not here to play, to dream, to drift;
We have hard work to do, and loads to lift;
Shun not the struggle—face it; 'tis God's gift.
Be strong!
Say not, "The days are evil. Who's to blame?"
And fold the hands and acquiesce — oh shame!
Stand up, speak out, and bravely, in God's name.
Be strong!
It matters not how deep intrenched the wrong,
How hard the battle goes, the day how long;
Faint not—fight on! To-morrow comes the song.
—*Maltbie Davenport Babcock.*

Let us see what has actually been done in the way of preparing new projects for the fair. The Administration Building, heading on the east end of the drive between the Field Museum and Soldiers' Field, has been totally completed and is now in use. A replica of Fort Dearborn as it appeared in 1833 has been erected on the lake front at about 27th street. All the framework has been set up for the enormous Travel and Transport Building which will be just west of the Illinois Central tracks at 34th street. Two great drives have been built between the railroad and the outer drive to care for the traffic of people visiting the fair.

In continuing the work much has been planned in the way of construction for the coming year. Rufus C. Dawes, president of the fair, recently announced that $15,000,000 will be spent on buildings in 1931. They will comprise four major units. The first is to be the electrical group, consisting of three buildings,—one for radio, one for communications, and one for the development of electricity itself; the second will be made up of three large buildings that will be erected just south of Soldiers' Field; the third will be an example of Mayan architecture to be located at 30th street and the lake; and the fourth will be an exhibition hall to be built by the federal government.

HOW DOES MACHINERY AND our so called mechanical age affect the reigning economic and social problem of the day,—unemployment? Does machinery make idle hands? Here we have a very vital question which concerns science, economics, industry, the home, and, in fact, nearly every institute of society. This topic has, since the beginning of the Industrial Revolution in England, always been a topic for discussion but within the last few years it has come to the front with greater force because of the unusual increase in unemployment.

That improved machinery brings about unemployment is an old and time worn argument. It will be remembered from history, how at the start of the "machines' reign," laborers fought against them even to the extent of destroying or rendering them useless, so that their employers were required to hire the hand laborers back on the job. They refused to look at the machine in any more than a strictly selfish way. They failed to realize that new industries and new jobs must be created whenever a machine supplants a hand laborer. They failed to consider the industrial and economic makeup of society as a unit or as one great business.

As statistics show, local unemployment may temporarily ensue as the result of rapid changes in production processes. Usually, however, mechanization proceeds slowly and allows the proper adjustment to take place simultaneous with the changes. Based on a survey of the National Industrial Conference Board and data obtained from the United States census of manufacturers for the year 1925, we see that 71 wage earners instead of 100 and 82 managerial and supervisory persons instead of 100, produced the same physical volume of production as obtained in 1914. Here the question arises as to what has become of the 29% of the workers without whom the same amount of production is now being carried on. The answer is that although productive output per wage earner between 1914 and 1925 had increased by about 40%, the total manufactured production during the same period increased over 65% and necessitated an increase in the required force of about 1,500,000 wage earners.

Five major industries, namely, automobile, radio, motion picture, chemical, and electrical, which have developed greatly in the last twenty years due to the mechanization of industry, now alone give employment to nearly 30,000,000 people. Therefore, in spite of the fact that machines may appear to materially affect employment when considered locally, we find that when the situation is taken as a great national problem and statistics are taken over a widely distributed population, there will be very little variation in employment due to "mechanical men."

COLLEGE NOTES

A. S. M. E.

The A. S. M. E. held a meeting, November 21, in Science Hall. C. T. Link, president of the Armour branch of the A. S. M. E., opened the session by introducing the president and then the field executive of the Chicago branch of the parent organization. The men introduced gave short addresses after which a representative from the Standard Oil Company of Indiana spoke on "Oil, Its Purification and Uses," illustrating his talk with motion pictures.

There were three reels of motion pictures, the first two dealing with the purification of the oils. The crude oil was shown to be a mixture of impurities and the heavier hydrocarbons, the purification of which was accomplished by filtration and steam distillation. In connection with the purification talk, pictures were shown of the laboratories of the Standard Oil Company in Whiting, Indiana, where tests on oils, and viscosity tests under varying temperatures were clearly demonstrated.

On the evening of November 21, the A. S. M. E. had its first smoker of the year at the Theta Xi fraternity house. After a number of rounds of bridge, silence was called, and the pledges of Pi Tau Sigma put on several stunts.

Important guests of the evening were Mr. R. Leonard, secretary of the A. S. M. E. in Chicago, as well as several Professors of Mechanical Engineering from Armour.

W. S. E.

"Illinois Waterways" was the subject of a talk presented November 20th to the Armour branch of the Western Society of Engineers by Mr. W. M. Smith, assistant chief engineer of the Illinois division of Waterways.

Mr. Smith's address was given with the aid of colored slides of various waterway projects. A large part of the time was devoted to a description and explanation of the water way along the upper Illinois River. Mr. Smith's talk started with the early forms of canal and river transportation and went through the various steps of development to the modern methods of today. He pointed out that although to the novice it would appear that there is less river traffic now than in former times, in reality there is probably more because of the increased carrying capacity of barges over motor driven boats.

Mr. Smith described the construction and maintenance of the large modern canal locks, using as examples those recently installed near Chicago.

Mr. Smith is well known in engineering circles and was a member of the advisory board on the design and construction of the Panama Canal.

Our Varsity Captains

Swimming

Edwin H. Knox

Edwin H. Knox, a senior, will captain our swimming team this year,—a team which expects to be the best that Armour has had in years. Ed has put his men through practice early this season under the direction of Coach McGillivray who is one of the outstanding coaches in the west. Practices with other schools have also been arranged in order to keep the men in good shape at all times, as some of the competition will be from the Big Ten colleges.

Edwin H. Knox

Knox has been on the Armour team for the past three years and has exhibited his ability with great success. Previously he attended Englewood high school in Chicago, where he was captain of the team. During his last two prep years, Ed was the high point scorer for his team, which in 1924 won the city high school championship and later gathered up the Cook county and National championships.

During the past few years, Ed has worked out with some of the greatest swimmers in the world, including Johnny Weismueller, Arnie Borg, Al Schwartz, Charley Lefgard, Dick Howel, and others.

Knox is enrolled in the department of fire protection engineering, and he is a member of the Honor A society and also the Phi Kappa Sigma Fraternity.

A. I. Ch. E.

At the second meeting of the semester, Professor McCormack gave a report of a convention at Detroit. To this convention were invited the student sponsors and the heads of the department of chemical engineering of the different schools.

Professor McCormack stated that attempts were made to bring more harmony between the student and national chapters of the A. I. Ch. E.

A great deal was done for the student chapters of the A. I. Ch. E. in having the following resolutions passed:

To have graduates as associate members;

To provide space in the bulletins of the A. I. Ch. E. for news of the student chapters;

To give more consideration to the student chapters.

This being the conclusion of the report, the speaker of the day was introduced. He was Dr. Bartow, head of the department of chemical engineering at the University of Iowa. The subject of Dr. Bartow's talk was the "World Engineering Conference in the Orient." This talk was accompanied by pictures of his travels in the Orient.

A. I. E. E.

Two student talks were given at the regular A. I. E. E. meeting held November 3rd in D Mission.

The first talk was given by T. S. Tryzna on "Prospecting by Electrical Methods." In this he explained that the presence of iron and other metals may be detected in the earth's crust by means of electrical devices.

The second talk was given by R. G. Kellner on "The Electrolysis Problem as Dealt With by the Illinois Bell Telephone Company."

F. P. E. S.

"The Principles of Underwriting" was the subject of the address given by Mr. R. H. Peterson, Western Examiner of the Springfield Fire and Marine Insurance Company, at the meeting of the F. P. E. Society Friday, December 5th. About sixty students were present at the meeting.

Mr. Peterson spoke in detail on the various major conditions to be considered in deciding whether or not to insure any certain plant or piece of property. According to the speaker, one of the most important considerations is the character and efficiency of the manager of the property to be insured. A man of indecisive character cannot maintain the proper carefulness among his employers, thus appreciably increasing the danger of fire.

In closing, Mr. Peterson spoke of the presence of nearby fireproof buildings as a condition which would tend to make an acceptable bid of one that would otherwise be unattractive.

Track Team Begins Indoor Season

A good turnout, for varsity track, was experienced Wednesday, December 3rd, when the first call was given by Coach A. A. Stagg, Jr. About twenty-four men appeared at the preliminary meeting held in Science Hall. Among them were men with track experience and also several newcomers, of whom much is expected. Short talks were given by Coach Stagg and also the Captains, H. L. Fox and F. M. James.

Among the old timers who are back with the squad are A. H. Jens, K. S. Hirsch, A. H. Helmic, J. T. Sorenson, R. A. Timmermans, F. Podlipec, and E. E. Sademan. The new men who are working hard for a place on the team are H. P. Nelson, W. A. Holland, R. Barnett, and C. J. Jens.

Work is now progressing rapidly and the nightly practices in Bartlett Gymnasium are gradually rounding into shape a track team which promises a most successful year.

As yet no meets have been definitely decided upon, but negotiations with several schools have been made with the idea of seting the dates of the meets later. Letters have been written to such schools as Beloit, Crane, Wheaton, Lake Forest, Chicago Normal, Loyola, and Morton.

In the last few years the general interest in track has picked up considerably, indoor and outdoor track alike sharing this interest. This year the interest shows indications of becoming still stronger, for the team shows promise of having a most successful season.

Dr. Thomas Brings Robot to Assembly

The assembly, held November 25th, proved to be of great interest to everyone that attended. This is the first time that a lecture and demonstration of this kind was given to Armour students. Dr. Thomas, the lecturer, has done a great deal of research work in the perfection of the grid glow tube.

Among the highlights of the demonstrations were powerful charges of artificial lighting, perfect synchronization of bulb flashes with a fan revolving at a speed of four thousand revolutions per minute, and Rastus Robot, the mechanical man.

Of particular interest was the scanning fire extinguisher demonstrated by Dr. Thomas. This device scans the area which it guards and if there is a flame it stops motion and squirts out the extinguishing agent until the flame is extinguished and then continues its motion, repeating the operation if there is another flame present.

Basketball Team Starts Season Successfully

In the first of the two practice games played this season, the varsity squad emerged victorious over the Bakelite Corporation stars by a score of 33 to 24. The second tilt ended in favor of Chicago University by a 32 to 20 score. Since both games were not on the schedule, Coach Krafft varied the lineup considerably, as he was seeking a first squad. He has now evolved a group that functions smoothly.

In the annual game against the Alumni, the varsity carried away the honors by a decisive score of 44 to 18.

BASKETBALL TEAM 1930-31

Reading left to right, front row: O'Connor, Lind, Meade, Moskovitz, Ott, Setterberg, Rutkowski. Back row: Coach Krafft, Miran, Gustafson, Captain Robin, Beemsterboer, Rossing, Kukulski, Manager Erland.

An overwhelming victory over Chicago Tech was the result of the next game, and then the Krafftmen turned their attention and hard fight against Wheaton for another victory by a score of 36 to 33. In the latter game both teams scored continually through out both periods. Near the end of the game, a 33 to 32 score favored Wheaton, but a well directed free throw by Captain Robin, followed by a field goal by Gustafson, put the Techmen in advance. Following Gustafson's basket, the game continued in a hard struggle as both teams fought to get possession of the ball. The game ended shortly after Ott shot another free throw.

The next foe was Western State Normal from Kalamazoo with its last year's record of no defeats. This game brought forth some of the hardest and snappiest fight experienced this season. Although the Normal men lived up to their record by winning 38 to 30, the game proved to be the best played this season with many thrilling events and good work by the men.

Harvey Rossing has been constantly leading the team in basket throwing. His good floor work has also made him an outstanding player on the team. Captian Robin, second to Rossing in scoring, should also receive credit for his leadership. Other men on the squad that have starred recently in the games are Lind, Ott, Gustafson, Miran, and Rutkowski.

Swimming Team Begins Difficult Schedule for 1930-31

With the return of practically all letter men, the swimming team has hopes of a brilliant season. Coach McGillivray and Captain Knox expect an excellent combination of the veterans with the new performers of such promising ability as Paul, Thompson, Brockman, and Koenig.

A vigorous schedule has been drawn up for the aggregation. At the Big Ten Swimming Conference held during the week of December 8th, Manager Davidson succeeded in arranging contests with Purdue, Wisconsin, and Michigan. These meets, together with the regular competition of a number of colleges and Y. M. C. A.'s, will constitute an interesting season for the swimmers.

The first meet of the season was held with the Hyde Park Y. M. C. A. on December 17th, resulting in a 33 to 33 deadlock. It will be remembered that the Hyde Park squad placed a close second in the Y. M. C. A. State Conference last spring. Armour took three of the seven first places: the 100 yard backstroke, the 220 yard crawl, and the fancy diving event. The winners and runner-ups of all events were as follows:

40 Yard Freestyle

Cookman, H. P.
Knox, A.

100 Yard Backstroke

Weston, A.
Gorsel, H. P.

220 Yard Crawl

Weston, A.
Juel, H. P.

100 Yard Breast Stroke

Wright, H. P.
Cavanagh, A.

100 Yard Freestyle

Crookman, H. P.
Knox, A.

150 Yard Relay

Hyde Park.
Armour.

Diving

Thompson, A.
White, H. P.

Dr. Randall Speaks at Assembly

At an assembly, held Thursday, November 20th, a discussion of the state and progress of the countries of the world was given by Dr. John H. Randall, who is director of the world unity fountain.

Dr. Randall was introduced by President Raymond and proceeded with a "trip" around the world showing the localities which seethe with unrest and possible open revolt. It was evident from Dr. Randall's talk that the United States is in very favorable circumstances compared to the rest of the world.

Tau Beta Pi

Tau Beta Pi, honorary engineering fraternity, selected the following men from the student body for its pledges:

D. M. Fetterman, E.E., '31.
K. E. W. Hellsen, C.E., '31.
F. M. James, F.P.E., '31.
A. J. Lenke, F.P.E., '31.
P. E. Seidelman, F.P.E., '31.
F. F. Strassenburg, M.E., '31.
R. H. Stevenson, M.E., '31.
J. C. Cavanagh, Ch.E., '32.
C. J. Robin, C.E., '32.
S. M. Lind, Ch.E., '32.

The men were presented pledge pins by Dean Penn. Professors Heald, and Grafton were present. Alumni from the Armour Chapter, which is the Illinois Beta Chapter, and from the Purdue Chapter, which is the Indiana Alpha Chapter, were also present.

On Wednesday, December 10th, the above pledges were sent through their initiatory rites and were given their keys.

Scarab

Scarab, honorary architectural fraternity, announces that its new initiates are to be:

R. A. Peterson, '32
D. M. Braun, '32
C. M. Schock, '31
E. J. Minx, '31

A. J. DeLong was the delegate from the local chapter to the convention held at West Virginia in November. During the past few months several alumni luncheons have been held in Field's grill and additional ones are planned in the near future.

Sphinx

Sphinx, honorary literary fraternity, has been assisting the Press Club in the past month in securing a speaker for the all-publications smoker which is to be held early in the next semester. Plans are being formulated for the first smoker of this type ever to be held at Armour. A record crowd is expected, for the speaker is to be a man prominent in the publication field.

Pi Tau Sigma

Pi Tau Sigma, honorary mechanical engineering society, pledged the following men at the Sigma Kappa Delta fraternity house:

Harold H. Fox, '31.
Andrew S. Hartanov, '31.
Mitchell J. Lamka, '31.
Fred T. Munch, '31.
Newton C. Cannon, '32.
Harold R. Davis, '32.

Professors Gebhardt, Roesch, Libby, Peebles, and Huntley, and several alumni members were present at the smoker.

Alpha Chi Sigma

Alpha Psi chapter of Alpha Chi Sigma Fraternity was installed Saturday, December 13, by members of Upsilon Chapter of Northwestern University under the direction of Dr. Walter S. Ritchie, Grand Master of Ceremonies.

The proceedings started at two o'clock in the Mission building and were concluded at an installation banquet given at the Y. M. C. A. Hotel in the evening. Twenty members of Upsilon Chapter were present to conduct the installation, and about fifteen members of the Chicago professional chapter of the fraternity lent their assistance.

The following men were installed as officers of the new chapter:

F. B. Attwood, Master Alchemist.
G. J. Stockman, Vice Master Alchemist.
I. B. Lehman, Treasurer.
J. O. Cavanagh, Reporter.
R. H. Blom, Recorder.
O. R. Steinert, Master of Ritual.
A. F. Bigelow, Alumni Secretary.

A total of thirty-two petitioners were present and were installed as charter members of the chapter. Included in this number were Professors Tibbals, Carpenter, and Bentley.

Dr. Ritchie, who was in charge of the proceedings, is a member of the faculty of the University of Missouri at Columbia, Missouri. Dr. Ritchie made a special trip to Chicago for the purpose of conducting the rites.

Honorary Fraternity Banquet

The joint initiation banquet of several of the honorary fraternities was held in the Old Town room of the Sherman Hotel, Friday, December 19th.

The recent initiates of Tau Beta Pi, Eta Kappa Nu, Pi Tau Sigma, Chi Epsilon, and Phi Lambda Upsilon were guests. Alumni, actives, and faculty members were also present. President Raymond acted as toastmaster. The principal address of the evening was made by Mr. Allen Albert, who is assisting Mr. Dawes in managing the World's Fair of 1933.

Salamander

On Wednesday evening, December 3, Salamander, honorary Fire Protection Engineering Fraternity, held initiation ceremonies at the Delta Tau Delta fraternity house.

The following men were initiated:

H. S. Holt, '31.
F. M. James, '31.
F. W. Spaulding, '31.
P. H. Kesselring, '31.
W. M. Trauten, '32.

Professors Finnegan, Holmes, and Robinson, Mr. J. V. Parker, and Mr. Fitzhugh Taylor assisted in the proceedings.

Chi Epsilon

On Thursday, October 30th, Chi Epsilon, honorary civil engineering fraternity, held a pledging smoker at the Phi Pi Phi fraternity house. Refreshments were served and card games were played. A welcoming speech was given to the pledges by Eldon A. Johnson, president of the Armour chapter.

The following men were pledged:

C. H. Miller, '31.
R. E. Meagher, '32.
A. B. Auerbach, '31.
M. J. Morgan, '31.
F. E. Rutkowski, '31.

Eta Kappa Nu

Eta Kappa Nu, national honorary electrical engineering fraternity, held its 26th annual convention at Ames, Iowa, on Friday and Saturday, November 14th and 15th. Nu Chapter of Iowa State College was host.

Delegates from other schools who passed through Chicago were guests of the Chicago Alumni Chapter at a dinner given at the Hotel La Salle, Thursday evening, November 20th. Afterward, a meeting was held at the Lighting Institute in the Civic Opera building. A. R. Draus, of Delta Chapter, was the official Armour representative at this meeting.

The Armour delegation to the convention at Ames, consisting of W. Drigot, W. E. Penfold, C. Blahna, and R. Patzelt, made the trip by automobile.

The business session consisted of registration of delegates, discussion of topics, and the election of officers. G. H. Kelley, a former student at Armour, was elected president of the organization.

Phi Lambda Upsilon

Phi Lambda Upsilon, honorary chemical engineering fraternity, held a smoker Thursday night, November 6th. Professor Bentley and all of the active members of the organization were present. At this smoker, the following men were pledged to the fraternity:

Russell H. Blom, '32.
Jack Cavanagh, '32.
Edmund Field, '32.
Wm. A. Holland, '32.

Pi Nu Epsilon

A meeting of Pi Nu Epsilon, honorary musical fraternity, was held Monday afternoon, November 10th. At this time a tentative selection of candidates from the junior and senior classes was made.

Formal pledging took place November 24th. The men pledged were as follows:

F. F. Strassenburg, '31.
S. L. Bonvallet, '32.
P. H. Korrell, '32.

The Armour Alumnus

VOLUME XXII — JANUARY, 1931 — NUMBER 2

Alumni Officers Elected at Meeting Dec. 17th

John J. Schommer, '12, was again elected head of alumni body.

E. W. Hotchkin Appointed Western Mgr. of Ins. Co.

Everett W. Hotchkin, F. P. E., '10, was recently appointed Western manager for the Owens and Royal fire insurance groups. Before his appointment Mr. Hotchkin held the position of assistant to the Western manager.

It is interesting to note that Mr. Hotchkin, when he graduated with the class of 1910, was one of only two graduates in the department of fire protection engineering.

Father and Son Attend Alumni Banquet

At the recent alumni meeting something of more than usual significance took place. Clarence T. McDonald, '04, and his son Clement J., '29, both graduates in the department of electrical engineering, were interested guests. This father and son instance is perhaps the first of its kind at an alumni function.

Armour has just reached that stage of maturity where the influx of offsprings of old graduates can be expected. Mr. Ernest Kelly, Armour's faithful registrar, announces that those of the second generation now attending Technology are four in number. As time marches on it is reasonable to believe that the list will grow consistently.

Word is received that L. E. Mellor, Arch., '17, is an architect in Harlingen, Texas.

John Schommer Reelected To Office of President

At the banquet and business meeting of the Armour Alumni Association held December 15th, 1930, at the Bismarck Hotel, the officers for the coming year were elected. John J. Schommer, '12, who held the office of president during the past year, was again elected to that position. This came as no surprise to the fifty-five old grads who were present, for John was easily the leading candidate for the office. James C. Matchett, '07, was elected vice-president, while the position of secretary-treasurer went to Louis Hirsh, '14. Two men were chosen for the board of managers. They were E. F. Pohlman, '10, and J. A. Whittington, '14. H. A. Durr, '05, was elected to a seat on the advisory board, and Roy M. Henderson, '02, was chosen as a trustee. All of the balloting was in charge of a committee composed of Lee, Seick, and McCaffrey.

Several other items of business were also settled at the meeting. One of them was a report by the finance committee, composed of Pareira, Richardson, and Rumely, of their appraisal of the treasurer's statement submitted by Louis Hirsh. Another was the changing of several articles in the constitution. The first was the reducing of the number of meetings to one annual get-together which will be held each December. This, however, may be disregarded in the case of an emergency, when a special meeting can be called. The second was the changing of the time of nominations from April 1st to November 1st.

The entire evening was by no means totally devoted to business. One feature of the event was the absence of long speeches. Doctor Raymond and Dean Palmer both spoke, but their talks were short and to the point. Conservation and general discussion between old classmates held the stage instead of the old time-worn speeches. The evening was brought to a close with the showing of five reels of motion pictures.

It is reported that J. Stanley Farrell, E. E., '24, now holds the position of superintendent of railway electrification for the Pierce Electric Company.

Julius Lichtenstein, Ch. E., '30, is employed by the Tonawonda Paper Company, located at Tonawonda, New York. He is engaged in the recovery division of the soda manufacturing department as control chemist.

Louis Hirsh, '14, was chosen to hold the office of secretary-treasurer.

Honor "A" Banquet Held After Alumni Game

Following the exciting and very profiable basketball game from the varsity point of view, the Honor "A" Society held their annual fall alumni banquet at the New Southern Hotel. Athletes from each branch of sport at Armour received the coveted gold "A" watch charm. Due to the unfortunate mishap to Bill Downes in the last minute of the game, he and Johnny Manz were unable to attend the banquet. Gerry Schumacher, Scud Kuffel, and Vic Hofer were also unable to attend, but "Nap" Kara found time to come and demonstrated his loyalty and enthusiasm for the Honor "A," as did Martin Vander Velde

Coach Bill Krafft spoke about the present status of athletes at Armour and other schools, and mentioned the possible over-emphasis and professionalism of athletics at some colleges. Whereas many institutions, including some that Armour has played against in the past, have dropped baseball, basketball, and other branches of athletics, Armour continues to foster this interest and produce good teams. He skeched a mental picture of future successful intramural athletics at Armour and hinted the possibility of a massive field house with facilities for playing every sport and giving a fitting banquet for the Honor "A" Society.

George Von Gehr, '28, has completed a comprehensive study of patent law at Kent night school and is now prepared for work as a patent attorney.

R. D. Doubt, '28 and A. J. Frost, '30, are both employed by Armour and Co. and are located in Chicago.

PERSONALS

Elmer Geiger, E.E., '29, was recently in Chicago for a short visit. He was on his way to Santo Domingo where he will aid in the construction of a power dam.

Joseph Bechthold, F.P.E., '30, is working for the Missouri Inspection Bureau in St. Louis.

Chicago was recently visited by George Horras and Al Gunther, both fire protection engineers of the class of 1930. They are employed by the Oklahoma Inspection Bureau at Oklahoma City.

Don Smith, M.E., '30, is working in the electrical department of the Buick Motor Car Company at Flint, Michigan.

Al Winkler, M.E., '30, is working for the Stromberg Carburetor Company in South Bend, Indiana.

Dave Allen, F.P.E., '28, is employed by the Ohio Inspection Bureau and is stationed at Cleveland.

Harry L. Kreiger, F.P.E., '28, is now working in Columbus, Ohio, for the Ohio Inspection Bureau. He had previously been employed at Cleveland.

J. P. Edstrand, C.E., '30, and P. M. Cassidy, C.E., '30, are both working for the federal government. Edstrand is stationed in Kansas City, Missouri, while Cassidy is at Washington, D. C. They were both in Chicago during the holidays.

H. S. Vanderbie, '22, is now sales manager for the Gugler Lithographic Company, being located in Milwaukee, Wisconsin.

A note has been received from H. K. Murner, C.E., '24, who is living in the warm climes of Monrovia, California. He fails to state his occupation at the time, but asks to be remembered to his old friends.

W. H. Hamilton, Arch., '26, is now in the bond business in California. He may be addressed in care of the Hamilton Mortgage Company at Los Angeles.

Word is received that A. J. Danziger, F. P. E., '26, has been quite ill in the past year but is now once more in good health. Danziger is employed by the Iowa Inspection Bureau in Des Moines.

H. B. Maguire, F.P.E., '17, is now assistant to the vice-president and general manager of sales for the American Steel and Wire Company in Chicago.

Recent Armour Grads Parade to Altar

Arthur S. Hansen, E. E., '26, recently left the ranks of the bachelors and acquired a wife for himself. He is in business for himself as a financial engineer, with offices located at 160 N. La Salle Street in Chicago.

Carl E. Herbst, F. P. E., '27, is another grad that took unto himself a wife, having taken the fatal step last summer. Carl is working for the Chicago Board of Underwriters.

Fred M. Tayama, E. E., '29, was married last month in Los Angeles, California. The bride was Miss Chyoko Dorothea Shiina.

Music I heard with you was more than music,
And bread I broke with you was more than bread;
Now that I am without you, all is desolate;
All that was once so beautiful is dead.

Your hands once touched this table and this silver,
And I have seen your fingers hold this glass.
These things do not remember you, beloved,—
And yet your touch upon them will not pass.

For it was in my heart you moved among them,
And blessed them with your hands and with your eyes;
And in my heart they will remember always,—
They knew you once, O beautiful and wise.

—*Conrad Aiken*

Word has been received that John E. Tarter has been made superintendent of the Chicago plant of the Royal Baking Powder Company. John may be remembered as the lad who could tickle the ivories to a considerable extent. He was graduated as a chemical engineer in 1926.

Another Armour man, in the person of Albin Stabovitz, '29, has been added to the roster of Underwriters' Laboratories. He was graduated as a chemical engineer and is now engaged in doing research in that department for the Laboratories.

Three recent Armour graduates are reported as having joined the staff of the Bell Telephone Company. C. F. Vojtech, M. E., '30, is connected with their patent department, while R. J. Guenther, E. E., '29, and N. S. Ewing, E. E., '29, are engaged in work at their laboratories in New York City.

PERSONALS

Earl R. Hubbel, F. P. E., '26, has recently been engaged as special agent for the Owens and Royal fire insurance groups in Indiana. Hubbel was formerly employed by the Indiana Inspection Bureau.

Robert E. Kilbourne, F. P. E., '30, is now employed by the Mars Candy Company of Chicago.

Harry Goers, F. P. E., '26, is working as an automatic sprinkler engineer for the Wisconsin Inspection Bureau.

Word has been received that Harry M. Brostoff, C. E., '24, is now an attorney-at-law with offices located at 111 W. Washington Street in Chicago.

Marshal Whitfield, Ch. E., '30, is now taking graduate work at Columbia University. He was awarded a scholarship to that school last year.

Fred Rasmussen and J. B. Sitzler, civil engineers of the class of 1930, are engaged as engineers for the highway department of the state of Illinois.

Erling A. Wike, E. E., '28, is doing road inspection work for the New York Central Railroad.

The realm of teaching has attracted Paul J. Rupprecht, M. E., '22. He is an instructor in the electrical shop of Lindblom High School in Chicago.

Word is received that Robert Johnson, M. E., '30, is employed by the Armstrong Cork Company as a sales engineer.

John C. Segeler, M. E., '28, is the assistant chief engineer at the University of Chicago power plant.

R. R. Maguire, F.P.E., '22, announces that he is still connected with the Florida Inspection Bureau, but is now stationed at Pensacola. He had previously been working at Jacksonville.

R. H. Bates, C.E., '28, is now working in Peoria, Illinois. He reports that all is quiet.

H. C. Nissen, C.E., '27, has followed aviation as an occupation. He may be addressed in care of the B/J Aircraft Corporation at Baltimore, Maryland.

Jerome H. Linden, C.E., '24, who was formerly an inspector for the American Bureau of Inspections and Tests in Chicago, is now Secretary-Treasurer of the Linden Printing Company here. He is quite active and interested in the production of the "Cycle" and "The Armour Engineer."

Many Alumni Attend Honorary Banquet

Among those of the alumni who attended the banquet given by Tau Beta Pi, Pi Tau Sigma, Eta Kappa Nu, Chi Epsilon, Phi Lambda Upsilon, and Pi Nu Epsilon at the Serman Hotel on December 19, were: Prof. Ernest Freeman, '02, John Manz, '29, Paul Nemoede, '26, Prof. James Peebles, '04, Robert Peterson, '27, Prof. Daniel Roesch, '04, Paul West, '23, and Frank Zimmerman, '30. The alumni representation would undoubtedly have been much larger had not the Amour alumni banquet preceded it by only two days. However, it is hoped that many more will find it convenient to attend the next honorary fraternity affair of that nature and share the enjoyment of a similar program.

Jennings Receives Rating Among Tennis Stars

George Jennings, x-'30, was recently awarded second place among the singles stars of the Chicago area in the tennis rating. George Lott, the former University of Chicago ace, was allotted the position above Jennings. In the doubles competition, Jennings and his partner were given first place.

George, with his familiar left hand stroke, holds the distinction of being the best tennis player in Armour's history.

C. W. Farrier Aids in World's Fair Work

Much of the architectural work that has been done so far on the World's Fair to be held in Chicago in 1933 has been done by an alumnus of Armour. Clarence W. Farrier has been engaged for about the last two years in drawing up the plans for the buildings, layout of land, and the other projects for the Century of Progress.

Mr. Farrier was graduated from Armour in 1916 in the department of Architecture.

John Schommer Receives Prize for Catching Fish

In the last issue of the Armour Engineer, John Schommer was shown with some of his "catch" that he inveigled out of the waters up in Wisconsin last summer. Well, John got more than just the pleasure out of catching those fish, for the **Field and Stream** magazine awarded him a prize of fifty dollars in merchandise, obtainable at a local sporting goods store.

John immediately expressed his choice by taking the fifty dollars in hooks ,tackle, etc., so it looks like a bad summer for the fish next year.

Peacock Mixes a Little Hunting With His Engineering

Robert C. Peacock, C.E., x-'27, whose article on conditions in Liberia appears in this issue of the Armour Engineer, also gives us a few items about the engineering problems he experienced in Africa. He says:

"It is hardly possible for the individual working under the convenient conditions provided by modern civilization to conceive of the difficulties that arise in a place where it takes weeks and sometimes months to reach these same conveniences. This is especially true when the work is engineering, in which speed is essential, and delay in receiving necessary materials causes costly hold-ups in other operations. I have had some excellent opportunities to observe the ingenuity with which men can overcome just such troublesome situations during my stay of three years on the African West Coast. The project upon which I was employed called for a great deal of construction work on roads, bridges, power plants, radio, and buildings.

The skin shown above once belonged to a leopard that had the misfortune of running into Peacock and his gun. The hunter seems pleased.

"All materials had to be landed on the beach, after being lowered over the sides of a ship into native surf boats and then rowed through a rough, dangerous bar. This method was very slow and hazardous, and many materials were lost in the sea. This difficulty was finally overcome by designing and putting into service two flat bottomed steel barges powered with twin Diesel motors. These barges received cargo from the ships, carried it through the bar and thence fifty miles up a narrow, winding river. These were supplemented by a fleet of motor trucks which, however, could be used only during the four dry months of the year, the roads being practically impassable the rest of the time. The construction and maintenance of these roads were a constant source of trouble."

Peacock in the above discourse tells a great deal about the sorrows of his experience in Liberia, but judging from the picture shown above he also enjoyed at least one event in his three years there. The skin shown with him in the photo is that of a leopard which he killed.

Varsity Flattens Alumni By 44 to 18 Score

In the annual battle between the alumni and the varsity basketball teams, the old grads went down in defeat by a one-sided score. The final tabulations showed 44 for the varsity, 18 for the Alumni, and one bum knee for Bill Downes. The two factions congregated at the Eighth Regiment Armory, on the evening of Tuesday, December 9.

Gustafson, tech's star sophomore guard, drew first blood with a basket, but that was before Manz, Kuffel, and Company had begun to click. The former stars had a fast breaking combination and in the ensuing few minutes Kuffel and Schumacher each connected with the hoop, thus placing the alumni on the large end of the score. This was the only place in the game in which the alumni were ahead. At the quarter the count was Armour 6, and Alumni 5.

In the second quarter, the varsity began to work smoothly with Gustafson and Ott doing the majority of the scoring. Hofer's play for the alumni was ever potent and materially assisted in keeping the score near equilibrium. At the half the score stood Armour 18, and Alumni 9.

To the embarrassment of those weary souls on the floor, in the second half something apparently went haywire with the timer's ticker, for the third quarter exceeded the usually allotted time by ten minutes. Rossing and Lind found it rather easy to sift through the alumni defense in this time and were responsible for several baskets apiece.

In the final quarter the varsity team marched unimpeded on to victory, although Downes and Hofer bagged a couple of beautiful shots. A sad climax for the alumni was when Downes went down with an injured knee. Since the injured member would not respond to treatment, the game was considered finished with a final count of Armour 44, and Alumni 18.

The contest showed that the varsity has a better than average team and should give any group a tough battle.

LINE-UP

Alumni—18

	B	FT	PF
Schumacher, R.F.	2	2	1
Downes, L.F.	2	1	1
Kuffel, C.	1	1	3
Hofer, R.G.	1	0	3
Manz, L.G.	0	2	3
Totals	6	6	11

Varsity—44

	B	FT	PF
Robin, R.F.	3	0	0
Miran, L.F.	2	3	0
Rossing, C.	5	2	0
Gustafson, R.G.	3	0	0
Rutkowski, L.G.	1	2	3
Ott, L.F.	3	0	0
Lind, R.F.	1	1	2
Beemsterboer, C.	0	0	0
Kukulski, L.G.	0	0	0
Omiecinski, L.F.	0	0	0
Moskowitz, R.G.	0	0	0
Totals	18	8	5

STEPPING INTO A MODERN WORLD

THEY SHUT THE DOOR
ON HYBRID STYLES

Quantity production of equipment has long been practiced by the telephone industry. Telephone designers years ago shut the door on many hybrid styles—seeking first to work out instruments which could best transmit the voice, then making these few types in great quantities.

This *standardization* made possible concentrated study of manufacturing processes, and steady improvement of them. For example, the production of 15,000,000 switchboard lamps a year, all of one type, led to the development of a highly special machine which does in a few minutes what once took an hour.

Manufacturing engineers, with their early start in applying these ideas, have been able to develop methods which in many cases have become industrial models. *The opportunity is there!*

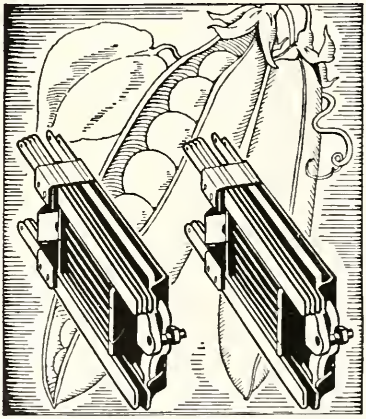
WESTERN ELECTRIC

keeps it locked against variations in Manufacture

In telephone making there is no such thing as "near enough." When a type of apparatus is decided on, it is up to Western Electric manufacturing engineers to produce *exact* replicas by the thousand.

To this end they have developed to the *n*th degree methods of precision manufacture. For instance, in the telephone receiver there is a tiny gap between the magnet and the iron disc which transforms electrical impulses into spoken words. In millions of receivers this space never varies by so much as the thickness of a bee's wing!

Keeping the door locked against minute variations from standard — which could completely destroy the efficiency of Bell System service—provides truly fascinating work.



"As like as two peas" are two—or two thousand—telephone relays of a given type. Western Electric men work steadily toward the ideal of absolute uniformity of product.

BELL SYSTEM

A NATION-WIDE SYSTEM OF INTER-CONNECTING TELEPHONES

UNBALANCED MOMENTS

AFTER ALL

Ott: "How do you know I started out as a bare foot boy?"
Erland: "Well, I wasn't born with shoes on myself."

They laughed when I sat down at the piano. Some simple fool had removed the stool.

A motorist had a slight accident with his light car on a country road. He limped to the nearest farm house and called the local garage.
"Hello," he said, "I've turned turtle. Can you do anything for me?"
I'm afraid not," replied a sweet voice. "You must have the wrong number. What you want is the zoo."

"Well I'll be blowed," said the goat as he bit into a stick of dynamite.

"That's one of our largest sky-scrapers," announced the guide.
Old Lady: "Oh, I'd like to see it work."

Boy: "Please, sir, I've called to see if I could get a job."
Small store owner: "But I do nearly all the work myself."
Boy: "That suits me, sir!"

Then there's that one about the Jew who had such a bad cold he couldn't raise his hands above a whisper.

WELL DONE

Newly: "This steak tastes queer."
Wed: "I can't understand, dear. I did burn it a little but I rubbed vasoline in it right away."

Frat: "May I borrow your tie?"
Frater: "Of course; but why the formality?"
Frat: "I can't find it."

Buzz: "Have a cigar."
Ted: "No, thanks; I'll just take the dime."

She: "Why, Jimmie, what's the matter? Why are you crying?"
Jimmie: "I don't see why I can't paint and powder my face when it's dirty the way you do 'stead of having to wash it all the time."

Dirkers (from second floor): "S' matter down there? Haven't you a key?"
Trauten: "Gotta key all right, but wouldja jussosoon throw down a few keyholes?"

TOO MUCH

Judge: "One dollar and ten cents for beating your wife."
Scott: "Why the ten cents?"
Judge: "That's the federal tax on amusements."

Duncan: "Why did you quit that game of strip poker?"
Hall: "I got cold feet."

IT IS RUMORED THAT THE FIRE PROTECTS WILL BE EMPLOYED TO DISCOURAGE SMOKING ON THE STEPS OF THE MAIN BUILDING.

MY ALMA MATER

Little: "Why the shaving soap on your vest?"
Cheetam: "That's my class pin, I'm from Williams."

Night Watchman: "Young man are you going to kiss that girl–"
James (straightening up): "No, sir."
Night Watchman: "Here then, hold my lantern."

She: "Very well then, I'll commit suicide."
He: "O.K. But don't let me find you hanging around here."

"Do you regularly attend a place of worship?"
"Yes, I'm on my way to see her now."

Prof: "I believe you missed my class yesterday."
Student: "Why, no, Professor, not in the least."

SIMPLE ENOUGH

Paul: "Did you have any trouble understanding the assignment today?"
Ed.: "No, sir; I didn't even read it."

Frosh: "Professor, do you think I can ever do anything with my voice?"
Prothroe: "Well it might come in handy in case of an accident."

A buck private was shaving himself outside in the open air when the sergeant came along.
Serg: "Do you always shave outside?"
Priv.: "Of course, do you think I'm fur lined?"

She (playing the piano): "My, how that song haunts me."
He: "It ought to; you just murdered it."

Black: "That man predicted my father's death three months ago."
Tan: "He must be a good fortune-teller."
Black: "No, he's the judge."

"Do you know Kate was a suicide blonde?"
"Suicide blonde?"
"Yeah, dyed by her own hand."

I asked my angel if she had her iron to-day? To which she replied, "Sir, I do not bite my nails!" The body may be viewed at the county morgue.

EVIDENTLY

Prof. Scherger says they couldn't have played cards on the ark since Noah was sitting on the deck.

Judge: "You are accused of stealing a chicken. Anything to say?"
Negro: "I just took it for a lark, suh."
Judge: "No resemblance whatever. Ten days."

Glen: "I say, my good man, will you drive me around town?"
Good man: "Yeh, if I can get a harness to fit you."

She: "And you've never loved any girl before me?"
He: "Of course not. Never before anybody."

"Where was Moses when the lights went out?"
"Just Moseying around."

The Production of Acetylene for Commercial Use

(*Continued from page* 51)

mosphere, it will overcome the pressure of the water in the seal, thereby creating a disturbance as it bubbles through with increased velocity. The generator operator on detecting the abnormality will then take whatever action is necessary to minimize the pressure. He may inject more water in order to lower the temperature, or he may be compelled to stop the generator until the excessive pressure makes its escape through the outlet gas line or automatic relief valve.

An air mixture in acetylene proves to be very hazardous in regard to the safety and efficiency of the apparatus. If a spark or flame is applied to a mixture of acetylene and three per cent of air, it will produce a violent explosion. If air is allowed to mix with acetylene, it will affect the heat intensity of the acetylene and will reduce the compressibility of the gas. The inlet valve on the generator serves to prevent the air from entering the generator. This valve is connected with the generator and the line leading to the gas holder. It operates automatically, opening when the pressure in the generator shell reaches a minimum and closing when the pressure becomes too great.

When the calcium hydroxide is dumped through the bottom of the generator, a vacuum is formed inasmuch as there is no means of displacing the discharged water. This vacuum invariably draws air, and since the glands, seams, and packing do not warrant an absolute seal, air holes would be created, allowing air to pass into the system. By the use of the automatic valve, acetylene is permitted to flow into the generator, displacing the calcium hydroxide. When the generator is emptied, a fresh supply of water is added, and in turn the acetylene displaced by the water is forced out through this same valve. Thus the automatic gas valve serves a twofold purpose: one to prevent excessive pressure, and the other to prevent a vacuum in the process of dumping and refilling the generator.

Another hazard that may arise in the generator is that of acetylene polymerization. Acetylene polymerizes at a temperature of 600°C. to form benzene, C_6H_6. At temperatures exceeding 600°C., styrolene is formed. Under continued heating, benzene and styrolene begin to dissociate, forming new compounds, among which are anthracene, hydrogen, and ethylene. The formation of benzene, however, is the only reaction that can be classified under polymerization, while the formation of the other compounds results through chemical reactions taking place following the application of heat energy.

The carbide to water generator is theoretically void of causing acetylene to polymerize, if the precaution is taken to see that the water supply is adequate. However, polymerization may result if the carbide is permitted to fall into a bed of its residue, calcium hydroxide. Unattacked carbide that lumps in calcium hydroxide readily evolves considerable heat, due to its inaccessibility to absorb enough water to bring on the complete reaction. So great is the evolution of heat energy under such conditions that a temperature of 780°C. can be reached in a short time, thereby causing all the reactions mentioned above.

Meteor

More beautiful than ships or 'planes
Are lightning-flash and thunderbolt
Of runaway night-frightened trains.

Swift, brutal in a wild assault
Of frantic wings and flying heels,
They leap from out the catapult

Of distance, thunder in their wheels
And lightning in their Cyclops' eye
And serpent tail, with warning squeals

As if shaken stars and sky
Were falling through the holes they rip
In night and silence. Demon cry

And dragon flight, receding, slip
Into the reticence of space
More terrible than 'plane or ship
In fiery speed and iron grace.

—*Benjamin Albert Botkin*

In order to prevent such an occurrence, manufacturers make it imperative that the residue be dumped immediately after the supply of unattacked carbide is exhausted. Generators are also so designed that the carbide hoppers never contain a quantity of carbide great enough to produce a large accumulation of the calcium hydroxide. Another feature to prevent polymerization is the use of a perforated grid, placed in the body of the generating chamber at about one-third the length of the chamber from the bottom. This grid receives all the lump carbide, preventing it from falling into the calcium hydroxide and leaving it exposed to the water.

The acetylene upon leaving the generator flows freely into the gas-holder, where the pressure is less than that in the generating chamber. The gas holder in an acetylene plant is of the same type as that of any holder of coal gas. It is always the practice in an acetylene plant to keep the bell of the holder as high as possible. Since the generating of acetylene takes place in the presence of large quantities of warm water, water vapor will form and mix with the acetylene. By keeping a large volume of gas in the holder, the water vapor will be given more time to condense and assume liquid form before the gas is pumped into the cylinders. The presence of water vapor is undesirable inasmuch as it renders acetylene less soluble in acetone, a solvent required in the compression of acetylene, and it further decreases the calorific value on account of its tendency to absorb heat when it decomposes.

Before acetylene is compressed, it passes through the purifying and drying system. The exact chemical structure of the purifying compounds used in acetylene plants today is not known, for different manufacturers use different compounds. The compounds, however, are closely related in composition. The simplest purification system is effected by washing the gas with water and a mixture of slaked lime and bleaching powder or with a solution of chromic acid in hydrochloric acid. The compounds most commonly used, however, contain kieselguhr moistened with cuprous chloride. Kieselguhr may be defined as being a porous, diatomaceous earth. It is the fine variously colored material derived from the accumulated deposits of the cell walls of diatoms.

The method of purifying acetylene with a purifying compound is very simple. The compound is merely placed in iron boxes on a grating, which serves to prevent the material from filling the inlet and outlet gas valve openings. The boxes are then covered to keep the gas from escaping. As the gas passes through the purifying material, the impurities are removed, phosphene (PH_3) being the principal substance. Phosphene is objectionable, owing to the fact that it adds phosphorus to the welding metal, impairing the quality of the weld.

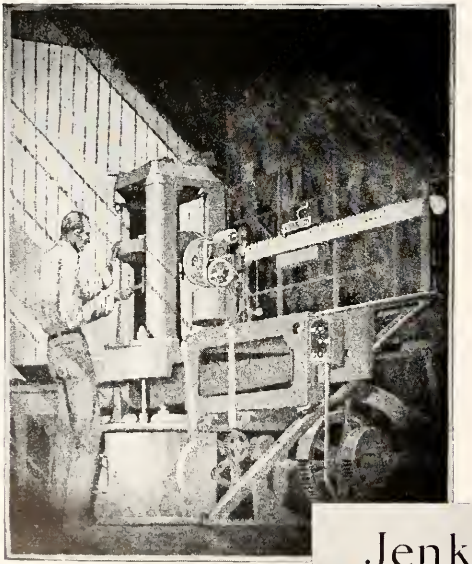
Water vapor in acetylene is extracted by means of passing the acetylene through unattacked carbide and calcium chloride. Newer methods, which are yet in the stage of experimentation, involve a cooling system. The gas is passed through a series of coils which are submerged in water that is constantly in circulation. The water vapor in the gas, upon cooling, condenses and then settles at the bottom of the drying tank. With the carbide and calcium chloride system, the water vapor is attacked by the carbide to form acetylene and calcium oxide. The acetylene is permitted to pass on while the calcium oxide is left behind. The calcium chloride driers dry the acetylene after it has passed all previous stages of purification and dehydration, so as to warrant a clean, dry gas for compression.

The compressors in an acetylene plant are similar to the standard air compressors. They are, however, operated at about only 80 revolutions per minute, pumping thirty to forty cubic feet per minute. This low speed is necessary in order to avoid creating high temperatures. As previously mentioned, the stability of acetylene when not dissolved in acetone and compressed into a porous substance is doubtful at pressures over 15 pounds to the square inch. Since the pressure in acetylene cylinders prepared for commercial use is 250 pounds at 70°F., acetylene must be compressed slowly and with perfect steadiness. It requires at least seven hours time to compress acetylene in a cylinder if good results are desired.

Acetylene compressors are unlike the air compressors in the respect that they must be lubricated with a greater degree of care and must be kept cool. Coolness of a compressor is maintained by keeping the gas chambers and piping submerged in water. Modern acetylene plants to-day equip the gas lines leading out of the compressors with safety valves that are regulated to pop when the pressure reaches a maximum of about 250 pounds per square inch. The use of a mercoid cut-out switch, which automatically stops the movement of the machinery when the pressure reaches the maximum point, further safeguards against running gas at exceedingly high pressures.

Acetylene, as previously mentioned, is compressed into cylinders to a pressure of 250 pounds per square inch. It is only because of the advent of the solvent acetone and the devisement of packing cylinders with a porous substance that the compression of acetylene was realized. The use of acetone in the cylinders causes the acetylene to dissolve, thus decreasing its volatility as well as allowing it to keep in higher temperatures. The use of acetone, however, does not alone solve all of the problem, and so asbestos and charcoal packing are also employed. It has been determined that a flash cannot travel through a tube of acetylene less than .5 mm. in diameter. By packing asbestos or charcoal in a cylinder to a porsity of 80 per cent, tiny cells are created each less than .5 mm. in diameter. If the cylinder containing the gas in these tiny cells was subjected to a jar or shock, it would be found that the explosion would not detonate the entire mass but would have to confine itself to some one particular cell.

As the use of acetylene continues to spread, the riveting process of joining steel plates promises gradually to become more obsolete. In time, an acetylene joint may be compared with the riveted joint in the same light as the steel nail of the present day is compared with the wooden peg of former years.



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Aircraft Engines

(*Continued from page 49*)

Fahr. This reduction is important as regards power developed (lower charge temperature and higher permissible compression) and also in reducing detonation. The spark plugs are individually air cooled. The relative power increase is nearly 200 per cent with a 60 per cent increase in weight. The supercharger drive has a clutch which is designed to slip when the engine is accelerated suddenly and thus voids undue stress in the gears and shafts due to accelerating the supercharger. The price is given as $7,188.00 or $12.50 per horsepower. According to Guy W. Vaughan, President of the Wright Aeronautical Corporation, engine division of the Curtiss-Wright Corporation, they have received an order from the Bureau of Aeronautics, United States Navy, for 272 Cyclone engines at a total of $1,974,019.30. An additional order from the Army Air Corps for 128 engines of the 525 H. P. type at a cost of $742,643.13 was also announced.

The Pratt and Whitney Aircraft Corporations have developed a heavy fuel injection system using an atomization device patented by Stephen A. Hasbrouch, one of their engineers. The system eliminates carburetors and permits fuels ranging from gasoline to furnace oil to be used in the same engine. A Boeing single seater plane fitted with a 450 H. P. Wasp Engine was operated on gasoline or furnace oil and the change-over made in the air. A throttle controls the air and also the fuel which is fed through individual lines to each cylinder head where the atomizer is located. The engine is provided with electric ignition and is not a Diesel engine.

The Packard Diesel has pioneered the heavy fuel oil burning compression-ignition aircraft engine field and is in commercial production. The engine showed its stamina by passing the Department of Commerce approval tests and by many hours of service. The engine has an electrically heated plug to facilitate starting in very cold weather. An inertia starter provided with a motor-driven accelerating device permits starting the engine from the pilot's seat. A single valve in the head serves for intake and exhaust. Streamlining is provided on various parts with a helical angle to follow slip stream direction. The power characteristic with altitude is very favorable. The weight is about 2¼ pounds per B.H.P.

The Beardmore Diesel has been especially designed for England's dirigibles with a view of decreasing fire hazards and increasing the cruising range. These engines were on the ill-fated Z-101 at the time of the unfortunate mishap recently.

The Junkers two-stroke Diesel having two pistons in each cylinder has been developed in Germany and creditable reports have been made of its performance. The Fiat has an oil burning aircraft engine using Bosch fuel injection equipment. The French Clerget Diesel has been a recent development and is built in the nine cylinder radial air-cooled type. The first engine is rated at 100 H. P. at 1,900 r.p.m. with 4.72 x 5.12 inches bore and stroke and nine cylinders. Its weight is given as 462 lbs. A larger engine is rated at 200 H. P. with 5.12 x 6.69 inches bore and stroke and weighing slightly over 600 lbs. This engine has the inlet and exhaust valves in the head with the fuel injector between the valves. The exhaust valves are located in the lowest part of each compression space and when they are raised from their seats by a decompression mechanism for starting or stopping, the excess oil is drained through the open valve. Individual fuel injection pumps are used with a fixed stroke of 0.400 inch. Control of fuel is effected by varying the axial position of the inlet port in the pumps. These may be independently adjusted to equalize cylinders and all pumps simultaneously adjusted by one lever for engine power control.

Blind

"It was too bad that newest man;
He had not worked here more than half a year
And had not learned the cautious use of fear.
When playing idly with his long oil-can
He looked away and got his hand too near;
We turned around to face that stifled yell,
I hear it sometimes in my dream of hell,
And saw his thumb and fingers in the gear.

"As for his work there's nothing much to do:
You watch the pieces feed beneath the hob
And watch the wheels go around until the bob
Releases, and you turn the table-screw.
I wonder who will get it now he's through?
God, it was soft. . . . I wish I had the job."

—*Robert Gates*

Automotive Diesel engines are represented in the United States by the Hill Diesel Engine Co. of Lansing, Mich., who have a 40 H. P. four cylinder unit weighing 400 lbs. and a six cylinder 70 H. P. engine in development. The Cummings Diesel has been used in automotive experimental road work with extremely favorable reports. Many Treiber Diesels, principally for marine work, have been successfully marketed. Besides the above Diesel engines which are essentially in the higher speed class we find many industrial Diesel engines giving meritorious performance around 1,000 r.p.m. operating speed. One interesting factor sometimes considered in the selection of engines for contractors' equipment is that the special fuel used precludes the use of this fuel for general automobile use and thereby materially lengthens the time between fillings of the main fuel supply tank of the industrial engine.

All engines flown in licensed aircraft must be approved by the Department of Commerce as airworthy. These tests are conducted by the Bureau of Standards at a special testing plant located at Arlington Farms near Hoover Field Va. Heavily reinforced concrete walls protect the observers from possible engine failure while it is operating on the torque stand. The plant was especially designed with three stands for type approval tests and can complete tests of about two engines per week. Each test consists of ten 5-hour runs, one at full throttle and rated speed and the remainder at 97 per cent of rated speed and 90 per cent of rated horsepower. No structural failure and not more than three forced stops for any cause are permitted. Each forced stop is penalized an extra two hours' run.

The performance tests are classified in the following ways:

(1) Power:—Power versus speed of an engine under normal operating conditions is of prime importance and determines the characteristic curves.

(2) Fuel Tests:—The fuel consumption during the power tests should be less than 0.6 pound per brake horsepower per hour. More critical analysis shows the mixture ratio requirements and the ability of an engine to operate at a lean mixture (with less than maximum power) and thereby very substan-

tially increase the cruising radius. The necessary minimum requirements of the engine as regards fuel volatility and anti-knock value are important phases of the tests available.

(3) Lubrication:—Investigations of lubrication include the range of pressures for safe operation, the effects of oil temperatures upon pressure with different lubricants, the variations of engine friction with changes in operating conditions, and the old consumption.

(4) Temperature Tests:—Cylinder and bearing temperatures give important information correlative to the life, friction, and general performance of an engine.

In a 1930 Summer Meeting of the (British) Institution of Mechanical Engineers, Mr. A. H. R. Fedden gives pertinent comments on engine design. The controversy between air and water-cooled engines may be inspected from curves which accompany his paper. The B. M. E. P. in lb. per sq. in. is a direct measure of the power output and for an all-American average shows an increase from 112 to 139 with increasing compressions from 4.5 to 7.5 volume ratio. The volume ratios correspond to a range of about 75 to 170 lbs. per sq. in. compression pressures with some accompanying difficulty of the high value attainment for large air-cooled cylinders. The anti-knock fuel requirement for this range of compression may also be noted in passing as being from about 50 to 85 percent on the Octane Heptane scale of anti-knock values. The higher anti-knock values represent special fuels which are not commercially widespread and without which an engine of high compression may easily be damaged if not carefully operated. The practical aspect of providing engines which can use universally marketed gasoline is commercially important. Difficulties with pre-ignition may become equally important to the anti-knock requirements and involve knowledge of the spontaneous ignition point of fuels under cylinder pressure conditions. The relative ignition temperatures of fuels at atmospheric pressures may be reversed at higher pressures.

The curves in Fig. 1 from data by Mr. Fedden show the relative weights of air-cooled and water-cooled (less cooling equipment) American engines with the substantial flattening out of the curves at the larger powers. The radial air-cooled engines have been substantially improved in the drag by development of cowling but usually have commercially lower compression ratios with a slightly higher specific fuel consumption. The cited advantages are (a) simplicity; (b) light weight; (c) absence of water system; and (d) service qualifications of quick get-away, maneuverability, and less vulnerability. Any of these items may be the determining factor in a choice of design. The simplicity includes low first cost, fewness of parts, ease of repair, installation, and replacement, and for radial engines improved facilities for supercharging. Quotation from Chief of Air Staff, Marshall Sir Hugh Trenchard, while lecturing to the Cambridge Air Squadron several years ago: "In the event of another war the wastage of aeroplanes would be so great that the country which could most rapidly re-equip itself would most probably win the war."

BLUE ISLAND INTERSECTION

Six street ends come together here.
They feed people and wagons into the center.
In and out all day horses with thoughts of nose-bags.
Men with shovels, women with baskets and baby buggies.
Six ends of streets and no sleep for them all day.
The people and wagons come and go, out and in.
Triangles of banks and drug stores watch.
The policeman whistles, the trolley cars bump:
Wheels, wheels, feet, feet, all day.

In the false dawn when the chickens blink
And the east shakes a lazy baby toe at to-morrow,
And the east fixes a pink half-eye this way,
In the time when only one milk wagon crosses
These three streets, these six street ends,
It is the sleep time and they rest.
The triangle banks and drug stores rest.
The policeman is gone, his star and gun sleep.
The owl car blutters along in a sleepwolk.

—*Carl Sandburg*

A 450 H. P. water-cooled in-line engine, including 0.56 lb. per B.H.P. for water and radiator, weighs about 40 per cent more than a radial air-cooled and has the disadvantage of "plumbing" troubles which may cause 30 per cent of engine failures. Air-cooled engines permit placing machines in the air from extreme cold starts in a fraction of the time required for water cooled installations. The in-line water cooled engines have distinct advantages in stream lining, higher permissible compression, higher speed, and larger practical sizes of bore. Some of these advantages disappear when considering the Diesel air-cooled which is easier to cool than the carburetor engine. The Packard 225 H. P. Diesel is an example of an approved type air-cooled engine. Mr. Fedden's firm is reported to be experimenting with a compression-ignition single-cylinder engine of 7⅜ x 12 (512 cu. in.) with an output of 80 B.H.P. and a fuel consumption of 0.43 lb. per B.H.P. per hour. The need for better and lighter materials is progressing rapidly and we have the nitralloy steel and nonferrous forgings of magnesium and berlillium in anticipation.

The N. A. C. A. Report No. 355 by Oscar W. Schey and Alfred W. Young shows flight performance characteristics from which the following data and charts have been abstracted:

A modified D. H.-4 M2 plane was fitted with either of two Liberty engines previously checked for equal power while unsupercharged. One of these engines was fitted with a turbocentrifugal supercharger and the other engine fitted with a Roots type supercharger. The vane type of supercharger is a more recent development and was not reported in this data. The unsupercharged performance is for each supercharger mounted in place and operating, but with the controls set to give the least possible supercharging effects. The installations duplicated service practice as nearly as possible.

The total weights, including superchargers, special test instruments, and the pilot, were 4,300 lbs. for the Roots type and 4,350 lbs. for the turbocentrifugal type. A small booster radiator was provided for the additional cooling necessary during the supercharging flights. A 10.67 ft. diameter by 6.33 ft. pitch propellor (Air Service part No. 065323) was used and fitted with a calibrated hub dynamometer for power measurements. The pilot was instructed to maintain sea-level pressure at the carburetor as far as possible during the supercharging flights. This was done for the Roots supercharger by discharging the excess air through a by-pass valve and gradually closing the valve until at the critical altitude it was completely closed. The output of the turbosupercharger was regulated by venting to the atmosphere the engine exhaust which supplied the turbine rotor nozzles. The Roots supercharger was supplied with either of two gear ratios (3 to 1 or 2.4 to 1) and had a displacement of 0.382 cu. ft. per revolution. The impeller end clearances were 0.015 inches, which was subsequently found greater than necessary, providing precision-type ball bearings are used. For a complete description see N. A. C. A. Technical Reports Nos. 230 and 284.

The turbocentrifugal supercharger is described in Air Corps. Technical Report Serial No. 2365, is known as Form F-1A, and is rated at 20,000 ft. maximum altitude at which it can maintain sea-level pressure for an engine of 812 cu. ft. per minute displacement. Its maximum speed is 23,150 r.p.m.

The following performance charts show representative results. Fig. 2 shows the time-of-climb and the rate-of-climb curves for conditions as indicated with slightly better indicated ceiling for the turbosupercharger as compared to the Roots supercharger. It is to be noted that the unsupercharged turbocentrifugal supercharger is somewhat handicapped by the additional frontal area as compared to the Roots type supercharger, which later was mounted at the rear of the engine. The substantial superiority of either supercharged installation, as indicated by the curves, is evident at all altitudes, excepting from sea level to a few thousand feet. The importance is magnified with further advantages shown by improved economies of fuel at higher altitudes (shown in Fig. 5) and the prediction that future fighting will be at 20,000 to 25,000 feet altitude. The intersection of the rate of climb curves extended with the zero rate of climb obviously gives the absolute ceiling.

Fig. 3 shows the true air speed during climb and level flights at various altitudes for the two supercharged tests and the two unsupercharged tests. The higher level flight speed of the turbocentrifugal supercharger, especially at higher altitudes, is notable.

Fig. 4 shows the power delivered to the propellor during climb with similar power conditions as for Figs. 2 and 3. The turbo installation again reflects its particular points of superiority and its curve shows approximately sea level horsepower maintained up to 12,000 or 14,000 feet altitude. The corresponding power for the unsupercharged engine has dropped over 100 B.H.P. or more than 35 per cent.

Fig. 5 shows specific fuel consumption of the turbocentrifugal equipped plane with and without the supercharger in action. Beneficial mixture conditions of stratification and distribution, as well as improved mechanical efficiencies at the higher powers, have substantially contributed to the lower fuel consumption of the turbocentrifugal supercharged tests. The saving in fuel at 10,000 ft. altitude is approximately 13 per cent, which is available for increased cruising radius or an increased speed for a given distance. The increasing divergence of the two curves indicates even greater advantages in economies or speed at higher altitudes.

Editor's Note: This is the first of a series of two articles by Professor Daniel Roesch on aircraft motors. The second will appear in the March issue of the ENGINEER.

He was staking his future on those castings

Even though it was July 4 and a holiday, R. T. Crane, then a young man, was so eager to see his tiny new foundry in actual operation that he lighted the furnace, filled the crucible with metal, and poured his first castings. When the moulds were cool, and the first Crane products ready, he studied and cleaned and polished with inexhaustible care.

The little foundry has grown into the 347 acres of Crane manufacturing plants. Progress has brought rows of giant electric furnaces to take the place of his first crude one. The lightning rod couplings that he made on that day in 1855 have been expanded into a line of 33,000 items, meeting every modern valve and fitting need of the world's industries. But to this day, the example the founder set of intense personal interest and pride and care for the quality of each product remains a distinguishing mark of the Crane organization.

Just as the founder on that first day felt that his future rested with the quality of those couplings, Crane men are trained to feel that their company's reputation rests upon the quality of each valve and fitting they turn out.

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The Lindbergh Beacon

(*Continued from page 46*)

parabolic mirror, subtending an angle of 120 degrees, a positive crater with an angle of emission of 120 degrees, and a reflector size of 60 inches, giving a beam spread of approximately one degree.

A rather unique device is used in maintaining focus in the Lindbergh Beacon. Unless the light source is placed at exactly the focal point of the mirror, the beam spread is distorted, producing a consequent decrease in light intensity. In order to maintain the true focal position of the positive crater (which may readily burn back out of focus), a special lense is located so as to direct light through a slit, when an off-focus position is obtained. Beneath the slit a strip of thermostatic metals is located, which deforms under the temperature of the incident light and closes a circuit that alters the rate of carbon feed until true focal position is restored.

By carefully grinding and polishing the reflecting surface, it can be brought up to an efficiency of 98 per cent of incident light. It is important that the reflector be kept clean and free from light absorbing materials. This is accomplished by the use of an air blast directed over the reflecting surfaces, which continuously sweeps them clean and protects them against fracture by equalizing the temperature.

The ball of incandescent vapor resembles in every respect the great natural source of all light energy. It is as though inventive genius had taken a half inch of the sun's surface and placed it before a mirror to make the Lindbergh Beacon.

The Lindbergh Beacon is a tribute of inventive genius to the pioneer spirit that dares its life to vindicate man's mastership of nature.

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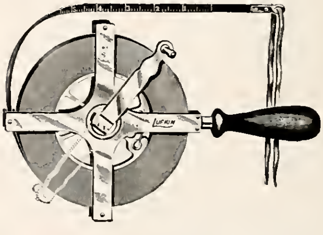

THE LUFKIN RULE CO.
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An Observation of Conditions in Liberia

(*Continued from page* 53)

summoned aid that an investigation was started.

The investigation has been carried on since the early part of 1930 and although the activities of the committee have been generally known to the residents of the African West Coast, their actual findings and decisions have not as yet been disclosed. The committee is composed of three men appointed by the League of Nations: an American, an Englishman, and a Swede. The American is a negro known in the States and in international circles and has proved to be most keen in the present investigation. The three men first went to Fernando Po to determine whether or not the status of the imported labor approximated slavery. Their findings there were grave enough to cause their return to Liberia immediately, where they have had a protracted stay, and to cause our own government to dispatch a Charge d' Affaires to the legation in Monrovia where previously a vice-consul was found adequate. The committee worked in Monrovia, the capital, and also took trips into the interior, visiting many villages and questioning many chiefs.

As previously stated, their findings have not been made public, but it is generally known that several of the highest officials in the government have been implicated. The advent of the committee in Monrovia gave the white residents some curious side-lights on the workings of the African mind which is still a thing of dark mystery to most of us with its worship of queer gods and its knowledge of things gruesome and terrible. There were men who had been involved in the Fernando Po business who could have given the investigating committee damaging information against some of the most powerful men in the country. Just before the committee arrived these smaller fry began to disappear. Two of them died on a launch during a short trip down the coast to Cape Palmas. Another met a similar fate in the interior. It seems a strange coincidence, if it was coincidence, that these people should disappear at such a convenient time. In such a country it would be rather simple for a man of influence to "remove" people who were distasteful to him. All natives have an intimate knowledge of the preparation and use of poisons. There are jungle trails dark and winding, bordered by mattings of impenetrable bush where a man could easily vanish forever. There are secret societies whose members are bound to do the bidding of those in power. One of the most deadly poisons is made from the gall of the crocodile; a fatal dose can be carried under the nail of the finger. It is required by law that the gall of a slain crocodile be removed and destroyed in the presence of witnesses, a law which, obviously, cannot be enforced in the remote interior areas. The natives, while they are not intelligent, are secretive about their own affairs. The whole situation with all its possible ramifications presents an unusually difficult problem and in some quarters little hope is held that the investigation will bring forth any real tangible information.

THE NIGHT HAS A THOUSAND EYES

The night has a thousand eyes,
And the day but one;
Yet the light of the bright world dies
With the dying sun.

The mind has a thousand eyes,
And the heart but one;
Yet the light of a whole life dies
When love is done.

—*Francis William Bourdillon*

It is conceded, however, that, whatever the results of the present intervention of the world in the affairs of this foster child of the United States may be, some radical change will have to take place in her form of government. There are already Americans there who supervise her financial offices, who train her soldiers, and who enforce sanitary measures in the city of Monrovia. The present bankrupt condition coupled with the slavery question seem to point to the establishment of an absolute protectorate as the only logical solution. The natural resources of the country possess the same potentialities as some country capable of developing them in the right way. It is with the other colonies on the coast and should be placed in the hands of interest then, that the companies and individuals now operating in Liberia are awaiting the outcome of the troubles of these people who profess a love of liberty and yet who are found sending their own men and boys to a life of slavery.

Engineering News

(*Continued from page* 55)

ter. Thus we have a situation in which pioneer work had to be done.

A large, heavy, reenforced concrete tower, or "obelisk" was constructed. Its form was measured so as to conform to the river bed as nearly as possible. The obelisk was placed at a convenient point upstream from the power dam, so that by blasting away a small portion of the pier it would be tipped into the river and become a dam. The pier itself was constructed of two parts; one part being arranged so as to be shot out by a charge of dynamite, thus leaving the obelisk unsupported on the river side. This block of masonry, 92 feet high, 45 feet wide, approximately 45 feet in the other dimension, and containing 5,500 cubic yards of concrete was dropped into the river, and it landed almost perfectly in the place in which it was computed to land. The result was a dam in the permanent channel.

It was necessary to leave considerable water flowing down the old channel in order to form a cushion for the obelisk to fall into and thereby prevent breaking it. The quantity of water was regulated, and this precaution worked very nicely.

When this massive block fell into the water, water was thrown from 200 to 400 feet in all directions. The obelisk was of such great weight and moved at such high velocity that even the swift river current did not affect it, and it settled into place as it was expected to do.

The entire scheme was a bold step in the pioneering field. It was planned and executed in such a successful manner that the engineer has established his own land dam.

Radio and Aeronautics

The development of radio aids to aviation is a measure of the future of aeronautics. Recent work in this field has revealed the trend toward automatic flying.

With the system of radio range beacons being installed, a need was felt for an automatic volume control on the receiving set used aboard the airplanes. Such a device has been developed which relieves the pilot entirely of the manipulation in the use of the visual indicator of the beacon signals. Another application of this instrument is being experimented with in blind flying. In connection with the automatic volume control, a deflection instrument is used which serves as an approximate distance indicator. Recent experiments have also added a means of indicating when the airplane is directly over the beacon, so that the landing field is thus conveniently and directly indicated to the pilot.

The deviometer is another instrument of wonder. By its use the pilot can follow any chosen course, within limits, on either side of the equi-signal line for which the beacon is adjusted. The deviometer is a shunting arrangement which varies the relative current in the coils actuating the two reeds of the reed indicator, and a pointer indicates the number of degrees off the equi-signal line for which the deviometer is set.

The value of such instruments is readily realized when they are functioning under the varying weather conditions. The obstacles which had to be overcome were many and of the most troublesome nature. The devices must operate under particular conditions of vibration with a small voltage input and yet be free from local interference.

The Thyratron Tube

Not since the earliest days of commercial application of electricity has direct-current transmission been considered practicable. In the electrical beginning of things when arc lights first came into use, followed a few years later by Edison's incandescent lamp, almost all transmission in commercial systems was by direct current. That was fifty years ago, before the wide-spread electrical net-works served an overwhelming majority of the nation's population.

The arc-lamp systems operated on the series circuit and started in 1879 and 1880 with pressures of 2,000 volts, but in more recent times they have gone as high as 8,000 volts. The incandescent system utilized the multiple circuit, and transmission was at the low pressures of 110 or 220 volts. These represent two methods of transmitting economically by direct current, but their disadvantages would be so pronounced if employed under present-day conditions, that the development of the transformer and the alternating-current systems that came in shortly before 1890 was little less than the salvation of electrical practice of that period. Since then practically all transmission has been by alternating current, but the economical advantages of direct current have inspired the engineer to search for such a means.

To this end, the thyratron tube has reached the present state after fifteen years of study and research. It is the most recent addition to the tube family, and is being used quite extensively as a controlling device. One of the largest present day opera houses employs such a tube for its entire lighting system.

Its greatest asset is the idea based on the expectation that the thyratron tube will transmit elecrical energy over long distances by means of direct current. A miniature experimental station has been set up to prove this idea. The artificial transmission line itself was represented by a copper bar about seven or eight feet long. Electrical conditions were imposed in the matter of ohmic resistance which made this line equivalent to a 400 mile transmission conductor in a commercial system. This is approximately 50 per cent beyond present practice.

SONNET

THE WORLD IS TOO MUCH WITH US

The world is too much with us; late and soon,
Getting and spending, we lay waste our powers;
Little we see in Nature that is ours;
We have given our hearts away, a sordid boon!
This sea that bares her bosom to the moon;
The winds that will be howling at all hours,
And are up-gathered now like sleeping flowers;
For this, for everything, we are out of tune;
It moves us not.—Great God! I'd rather be
A Pagan suckled in a creed outworn,
So might I, standing on this pleasant lea,
Have glimpses that would make me less forlorn;
Have sight of Proteus rising from the sea,
Or hear old Triton blow his wreathed horn.

—*William Wordsworth*

At the sending end of the line was installed a bank of thyratron tubes functioning as rectifiers to convert alternating into direct current for transmission purposes. At the receiving end of the line were installed other thyratron tubes which functioned in pairs as inverters. The source of current-supply for the experimental system was a bank of transformers which furnished alternating current at 15,000 volts.

When this interesting experiment was tried, it was found that transmission of the power was accomplished without difficulty. The tubes handled the current very successfully as rectifiers and inverters. Such success signifies of what may be in store at some future period in electrical engineering developments.

Measuring the Efficiency of a Cow

Electricity's latest task is a boon to the dairy industry. In the laboratories of the College of Agriculture, University of California, at Davis, California, there has just been completed a "respiration chamber" in which the input-output efficiency of a cow may be tested electrically. In fact, provisions are made for tests on two cows at one time.

The animals are provided with comfortable stalls in airtight chambers, and are fed, watered, milked, and cleaned under careful laboratory conditions. The feed is weighed, the water is analyzed, and the air in the chambers is cooled and humidified. Attendants who enter the chamber at regular intervals must pass through an air lock auxiliary chamber to prevent air leakage.

The breathing of the animals is measured by an elaborate "mechanical lung" device called an "aspirator", designed and built by Dr. Kleiber on the staff of the college. A classifier, in the basement under the respiration chamber, separates the waste products. About the only thing which is not analyzed by this machine is the cow's moo. The entire equipment is about three times the size of a large motor bus, and it cost nearly three times as much.

Through the use of the equipment, scientists may ascertain what effect, if any, the use of treated water, variation in diet, cooled air, or other controllable conditions may have on a cow's efficiency.

Dallas to Have Tallest Welded Building

A 100 percent electrically welded office building, 19 stories high, the tallest yet to be undertaken, is now being constructed in Dallas, Texas. Dallas is the largest city in the United States to sanction, in its building code, the use of welding in the construction of buildings.

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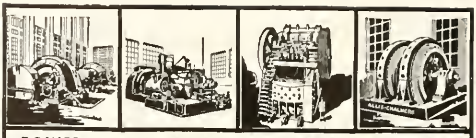

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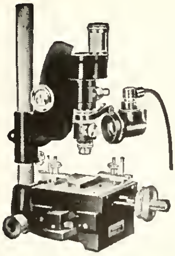

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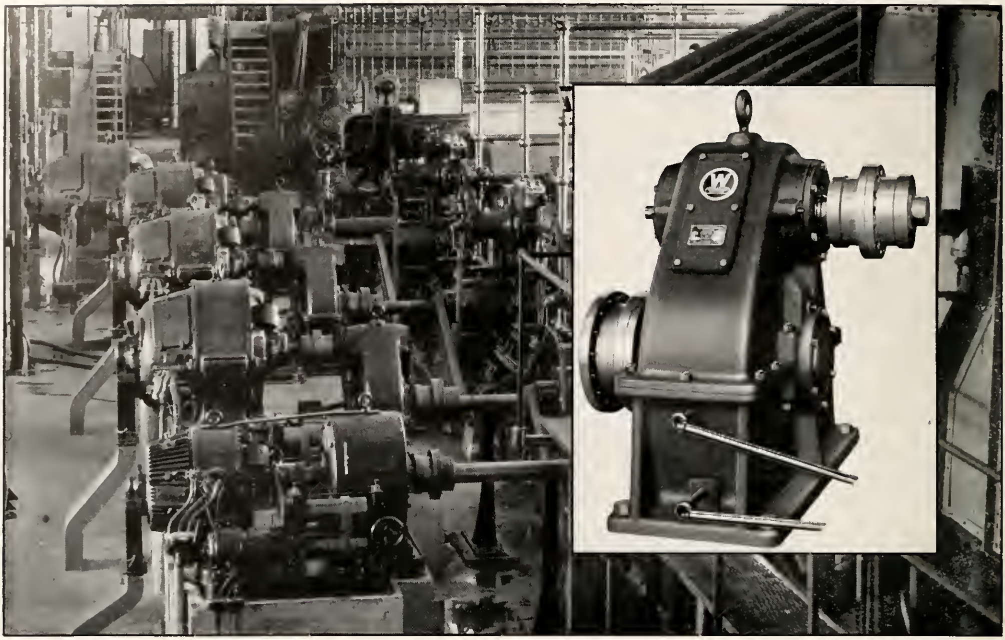

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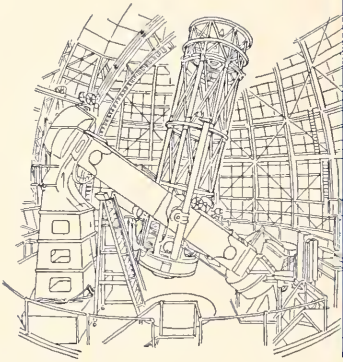

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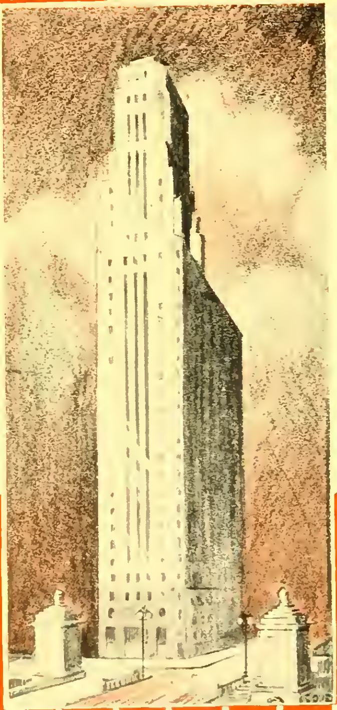

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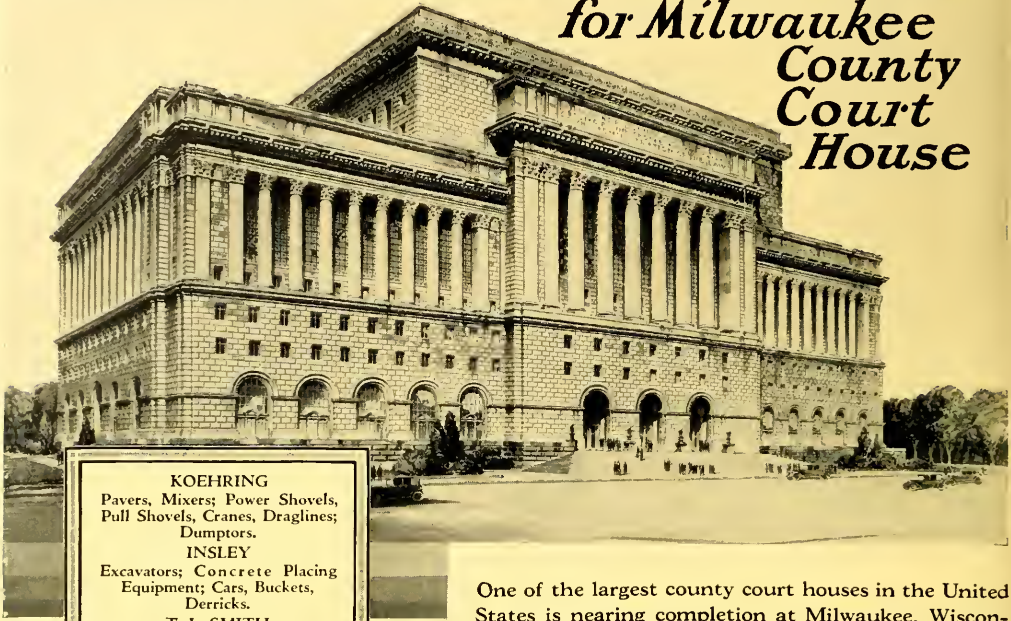
for Milwaukee County Court House



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Among the N. E. C. machines used on the Milwaukee County Court House was a large Smith Tilting Mixer of 2 yard capacity. With the famous Smith end-to-center mixing action, the big tilter mixed 10,000 cubic yards of concrete—Smith-mixed concrete for permanence.

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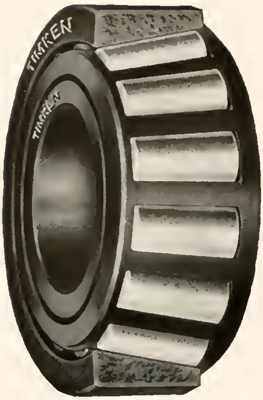

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ARMOUR INSTITUTE OF TECHNOLOGY

VOLUME XXII MARCH, 1931 NUMBER 3

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Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.

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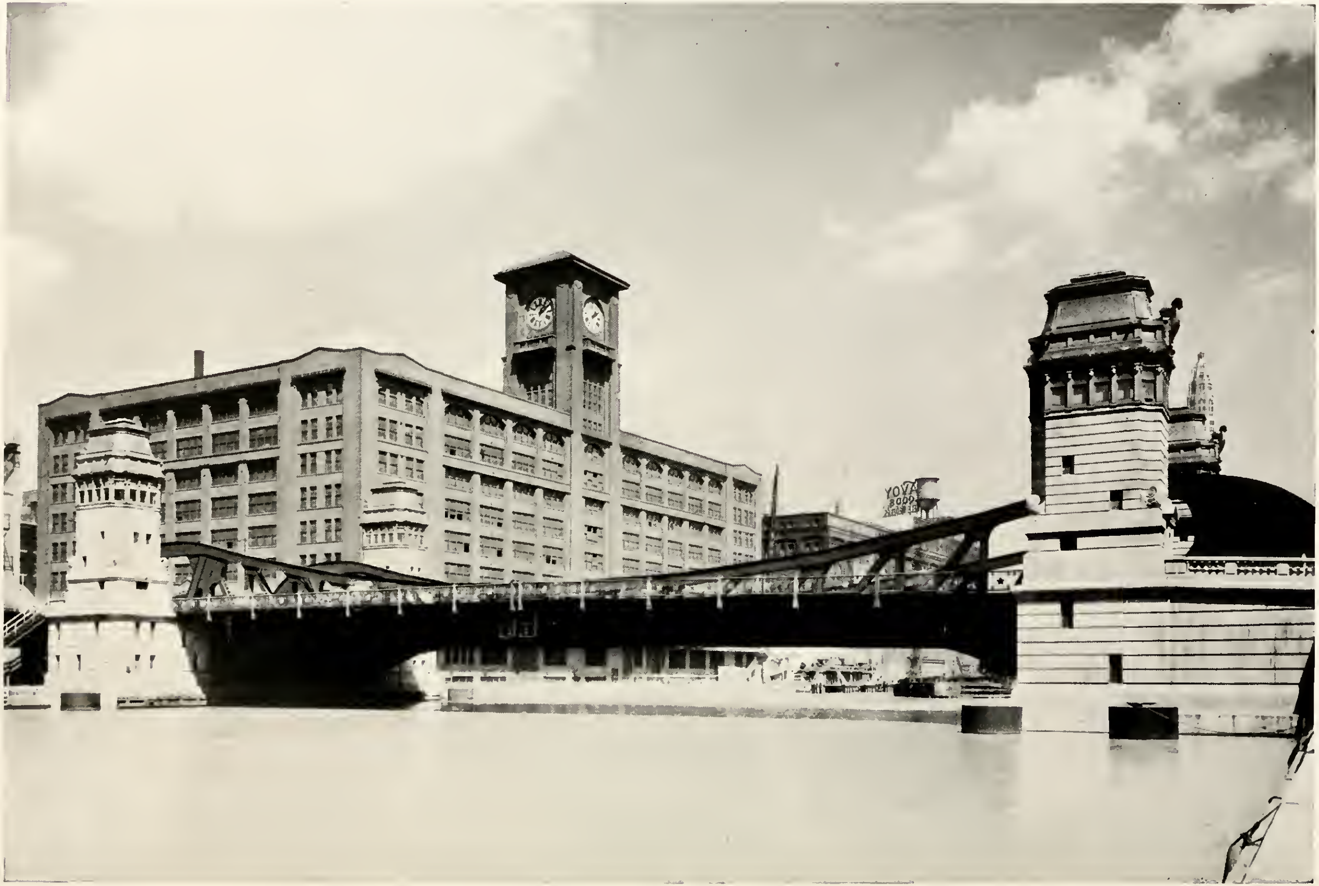


The La Salle Street Bridge — One of the Latest Types of Bascules

The
ARMOUR ENGINEER

VOLUME XXII MARCH, 1931 NUMBER 3

The Development of the Chicago Type Bascule Bridge

By **Earle G. Benson, '25**

Bridge Design Engineer for the City of Chicago

WHEN one considers that the forerunner of our present mighty lift bridge was a simple hinged leaf over a castle moat,—a means of defense against an invader,—it would appear that the evolution to the present high perfection had been a very gradual process. However, such was not the case for it soon became apparent to those early engineers that any type of lift bridge, counterweighted or not, could not be made any appreciable span with the materials then known or the operating power available. Consequently attention was turned to the self-balanced more easily constructed and operated center pier swing bridge. At the end of the nineteenth century the swing bridge had attained a high degree of development, progressing through the earlier stages of all timber construction to an all-iron structure operated usually by steam power.

The last few years of the nineteenth century saw the beginning of the practical application of electric power and the use of steel instead of wrought iron for construction purposes. These two elements, electric power and steel, made it possible to meet the demand for much bigger and better movable bridges.

The field for development was ready and, what was more important, it was now centralized. Ordinarily bridge installations were at comparatively large intervals on the more traveled rivers of the country, and the total number was few. However, the new metropolis of the prairies offered an entirely different situation. Chicago had grown up on a comparatively narrow river that ran a crooked course through the busiest section of the city and sharply divided it into three distinct portions, a north, south, and west side. So effective had been this division that the early settlers soon recognized that many crossings would be necessary to prevent any breach. Consequently, as early as 1829 rude log and pontoon bridges spanned the river at various points, and by 1834 a simple hinged span had been built at Dearborn Street. Later, all important streets were spanned by swing bridges. At the beginning of the twentieth century these were the prevailing type.

It might be well at this point to give a clear definition of what is meant by a bascule bridge, inasmuch as one so frequently hears this type referred to as "folding" or "jack-knife" bridge. The word "bascule" itself comes from the French, meaning "see-saw"; hence a Bascule Bridge means a balanced structure where the balance or counterpoise lowers as the roadway rises. Such is truly the case with the present day bascules for they are balanced in all positions and revolve about trunnions or pins located near the center of gravity, the counterweight sinking into a tailpit as the roadway swings into the air. There are now many types of leaf bridges having patented features with varying degrees of merit. To describe them all and point out the advantages or defects of each would

The concrete substructure of the bridge rests on massive concrete piers that are built down to bed rock.

be beyond the scope of this article.

It has been said that the Chicago River lent itself admirably to the development of bascule type bridges rather than swing bridges. The reason for this can readily be seen by considering the local conditions. To begin with it is well to recall the character of the Chicago River. Its main branch cuts through a portion of the business district; hence hundreds of thousands of people daily must pass over it to reach homes or places of business. Its north and south branches reach miles out into the industrial sections of the city and there great manufacturies have their docks and loading slips. Consequently, the largest lake steamers must ply almost its entire length. Furthermore, the concentration of business in the comparatively small area of the loop has made land so valuable that every foot of ground up to the river's edge must be utilized, and so the river has become bound in by docks to a width of approximately 200 feet for the greater part of its length.

In view of these conditions, it is simple to list the advantages of the bascule type bridge as against the swing bridge for this district:

(1) No center pier to obstruct navigation — the full width of the river being available for boat passage.

(2) Minimum space is required and approaches are easily built.

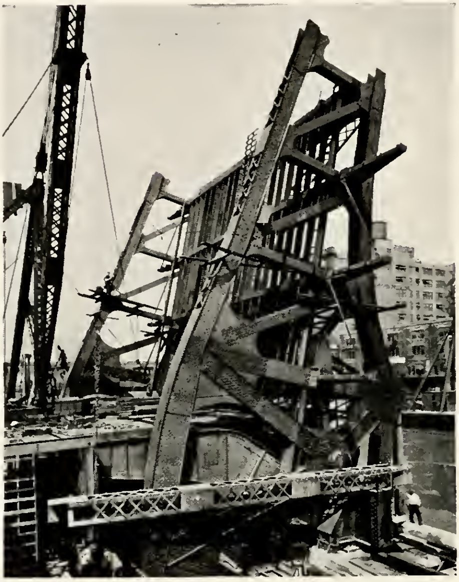
(3) Need not be fully opened for passage of small vessels; swing bridge must always be fully opened.

(4) Bascules have a shorter time of operation.

(5) In cities like Chicago where wide roadways are necessary, a swing bridge of considerable roadwidth narrows the channel when open.

(6) Bascules may be built side by side for railroad use without interference.

Appreciating these advantages and spurred on by the fact that many old swing bridges were beyond practical repair, the City of Chicago in 1900 decided to adopt a policy of replacing existing swing bridges with bascules. To obtain the best design possible, the Commissioner of Public Works, Mr. L. E. McGann, in May, 1900, invited competitive designs for a bascule bridge at 95th Street over the Calumet River where conditions similar to those on the Chicago River prevailed. The competition resulted in the submission of eight designs, three of which were prepared by the city's own engineers and the others by outside bidders. A committee of three prominent bridge engineers, consisting of Messrs. E. L. Cooley, Ralph Modjeski, and Byron B. Carter, were retained to judge the designs. They selected one of the city's own designs on which they recommended several modifications. This general design with some changes and improvements is the type used today not only in Chicago but in several other cities and is generally known as the "Chicago Type Bascule."



The movable leaf is kept in the upright position during its installation. Not until the machinery is put in place and the flooring ready to be laid, is it lowered.

It is interesting to note that in design this bascule follows the famous Tower Bridge of London, which was one of the first of large trunnion bascule bridges. The design accepted was a double leaf structure, each leaf having three trusses which were pivoted about three trunnions. The span was 128 feet from center to center of the trunnion bearings with a clear waterway of 100 feet between protections. To the rear of the trunnions the trusses extended back about 26 feet through slots in the fixed approach floor, under which was carried the cast iron counterweights. This design was of a semi-through type, having portal bracing at the trunnion end. Trusses were set 21 feet center to center and the outer two carried brackets for the sidewalk. The sub-structure consisted of a front and rear pier connected by walls so as to form watertight pockets into which the counterweights were to swing. Plate girders between the front and rear piers carried the trunnion bearings and also the fixed approach. Operating mechanism consisted of two gear trains below the street level driven by two 38 H.P. electric motors for each leaf. The main pinions of the gear train meshed with cast steel racks fastened to the curved heels of the three trusses, and the rack teeth were provided with openings to prevent dirt or ice from clogging the teeth. At the center the two leaves when closed were connected by shear locks consisting of longitudinally sliding lock bolts engaging in sockets in the opposite leaf.

Among the other designs submitted were several rolling lift bridges in which the curved heel of the truss rolled back on a track or revolved on rollers in a track of large radius. Several of the former type had then been built for the city and are in use today, the oldest being at the Van Buren Street crossing. However, the committee's reasons for favoring the trunnion type of bascule are given in their report as follows:

(1) "Constant point and direction of application of load on the foundation whether the bridge is in motion or is stationary." (On a rolling lift bridge the load moves back as the bridge opens and may cause unstability of foundations.)

(2) "Reduction of the number of moving parts to a minimum."

(3) "— the trunnion type of bridge is an old and tried one and is not covered by patents."

"The bascule design permits the placing of the center of gravity of the moving bridge in the trunnion axis on its proximity. The placing of the center of gravity a short distance from the axis of the trunnions toward the draw opening and the arrangement, as designed, by which the fixed approach floor relieves the tail end from any possible live load have the advantage that they tend to hold the bascule firmly in position when closed without absolute necessity for heel locks. There is no tilting effect due to the action of live load coming on the bridge."

Thirty-one years later it is interesting to note that the recommendations made by the Board of Engineers at that time, which were not all then accepted, have now been for the greater part incorporated in present design. Several of the suggestions were:

"—that adjustable resting blocks be placed in front of and near the trunnion so that when the draw closes, the load may be transferred from the trunnions to the resting blocks. This will facilitate lubrication—"

"—for future and more important structures, warranting additional expense, foundations should be carried to bed rock."

"The design of the piers is not satisfactory,—the proposed modification consists of making one counterweight pit by disposing of the partitions—"

New types of bridge covering have been developed since the advent of heavy automobile traffic. This particular kind is made up of asphalt planks laid diagonally.

How this first early design and the valuable suggestions of the committee have been developed into Chicago's modern type Bascule can be best seen by a description of any of the large bridges designed by the city in the last decade. This period has seen more intensified activity in bridge building than any other, and, while the evolution of each improvement is in itself interesting, the important thing is the composite result of these improvements.

The modern bascule consists essentially of three separate parts: (1) the substructure or foundations, (2) the superstructure, consisting of the leaves themselves and the operating machinery, and (3) the houses and enclosures which serve to protect the operating equipment.

The substructure of today is in reality a huge concrete box with walls four to five feet thick and resting on about six massive concrete piers reaching in most cases to bed rock. This usually means a depth of 50 to 100 feet below lake level. The top of the substructure is usually five or six feet above water level, while the bottom may be from 20 to 30 feet below water level, necessitating of course a water tight pit. On this substructure or "bridge pit" is mounted the pedestals and girders for the trunnion bearings, the river pier or "live load bearings," the anchor columns which secure the tail end of the leaf, the gear trains, and all the columns for the operating houses. The immense concentrated loads together with the earth and water pressure of the submerged parts call for a high degree of engineering skill in the design of reinforced concrete structures.

The superstructure consists of the movable leaf and its supports and the fixed approaches. Usually where conditions do not call for roadways of extreme width only two trusses are used. Depending on the approach elevations and conditions, they may be a pony truss, railing height truss, or deck bridge. The pony truss so commonly used in Chicago is a sort of low through truss with all portal bracing omitted. A rigid system of lateral bracing with deep floor beams and solid counterweight box serves to keep the trusses aligned.

The appearance of the trusses has changed vastly from the early bascules. Formerly, designed in accordance with the then existing loads and traffic, they were open, angular, and apparently spindly structures. Today instead, one sees a graceful curved arch in which even the gusset plates have radii. There is now beauty in the strength and massiveness of the structure. So great have the stresses become from the ever increasing design loads that today some cases require the use of nickel steel in the portions of the truss close to the trunnion. The magnitude of these loads can be appreciated when it is realized that although an arch in appearance, each leaf is but a cantilever with an arm of over a hundred feet.

Uniting the trusses, behind the trunnions and under the approach floor, is the counterweight box. These days the counterweight instead of being cast iron is concrete mixed with steel punchings where greater weight is required. Provision is also made for removable blocks of concrete in order that changes of balance can be adjusted and so that a condition of near balance can be maintained during the different stages of construction. It is perhaps needless to say that the bridge is erected in the open position and is not lowered until machinery is installed and the floor ready to be laid. This leaves the river open for traffic and all work can be done from derricks on the shore. The roadway is applied with the leaves horizontal.

The roadway of the bascule bridge offers an entirely different problem than the ordinary fixed highway bridge. On the latter type it is possible to use ordinary roadway paving such as brick or concrete slab. But with a bascule the roadway must remain in place when the leaf is vertical and must also be light in weight, yet need infrequent repairs or replacements. The earlier bridges used oak planking laid on oak or fir subplanking on stringers, the top surface of which later was changed to creosoted wood blocks laid with the end grain up. When the motor vehicular traffic became heavy, a rubber block paving was tried and gave excellent wearing surface. It was more skid proof than wood blocks and more easily repaired. This flooring is used on the Michigan Avenue link bridge on the up-

(*Continued on page 105*)

Fire Hazards in Airplane Hangars

By **H. S. Holt, '31**

Student in the Department of Fire Protection Engineering

DURING the last quarter of a century, aviation has developed from a mere dream to one of the leading modes of transportation. Thousands of passengers and thousands of pounds of mail are being carried by plane each day and statistics show that regular air transportation totals 90,000 miles per day. The numbers are steadily increasing.

The magnitude of this industry has necessitated the building of many hangars, some of which are very large. The rapid growth of air transportation is causing the hangars to be taxed to capacity for the storage and maintenance of the planes. From the standpoint of utilization of hangar space, this condition is efficient, but since it represents a greater concentration of valuable property, it increases the liability for protection from fire loss.

To the casual observer, the relatively great fire hazard in an airplane hangar may not be apparent. A more extensive study into the matter, however, will prove to him that the hazard is great. The first feature of hazard to consider is the construction of the hangar. Since the planes are quite large, and it is usually desired to house several planes in each hangar, the shed will cover quite a large area. This area is always open throughout the greater part of the hangar and not sub-divided into smaller divisions by walls or partitions of any kind. Such great expanses of open area contribute very materially to the spread of five. All of the area is subject to a single fire, and the large open space allows air currents to fan and propagate an incipient blaze.

In order to set a limitation on the size of hangars, the National Board of Fire Underwriters recommends the following limitations for areas between fire walls:

(a) Unsprinklered hangars .... 10,000 sq. ft.
(b) Sprinklered hangars (except as provided under c.) 25,000 sq. ft.
(c) Sprinklered hangars, when average height of hangar ceiling does not exceed 25 feet.. 30,000 sq. ft.

In regard to the height of the hangar, the National Board of Fire Underwriters recommends that it be not more than two stories in height if of fireproof construction, and not more than one story if of any other type of construction. It also recommends that there be no basement, cellar, or pit under the grade floor, except a furnace or boiler room which must be cut off from the hangar by fireproof construction and be accessible from the outside only. Heating ducts may be installed under the floor but must be covered over with masonry slabs, all joints being made oil and vapor tight. The recommended maximum height from the floor to the bottom of the roof trusses is 25 feet.

The type of construction in hangars varies quite considerably, as is the case in any other class of building. The best construction is fire-resistive with masonry or reinforced concrete walls and reinforced concrete roof; or with steel trusses and roof supports with all the steelwork protected with adequate fireproofing material. Hangars of wood construction, of course, offer very poor opposition to fire, while those constructed with unprotected steelwork are but slightly better. The steel, in itself, is incombustible, but the conditions prevalent in airplane hangars, as will be shown later, may cause fires which are intense enough to cause rupture and failure of the unprotected steelwork in a very short time.

The next important feature of hazard to consider in the hangar is that of the occupancy. The greater percentage of the

In one of the tests at Washington, D.C., gasoline was ignited on the floor of the hangar, thus setting fire to the wings of the planes.

Hangar fires spread very rapidly as is shown in this view taken 20 seconds after the start of the fire.

planes in use today have the framing in the fuselage and wings constructed of wood. The wood framing is covered with a muslin fabric, which is painted with a compound commonly known as "dope". This dope presents the outstanding hazard of the plane. It is a nitro-cellulose compound and has a very great fire hazard.

Nitro-cellulose is a chemical compound prepared by the action of nitric acid on pure cellulose. Its ignition temperature is low and it burns with a very persistent, hot flame. It is not only hazardous due to its ready combustibility, but also because the molecule contains enough oxygen to make it subject to decomposition even in the absence of air. Such decomposition will start with temperatures as low as 230 degrees Fahrenheit, and after it is started the temperature increases rapidly and the decomposition becomes very vigorous. This reaction cannot be stopped by smothering as can ordinary combustion. The only possible way of fighting it is by cooling the substance below the temperature at which the decomposition begins.

Nitro-cellulose is the main constituent of the dope used to paint the fuselages and wings of the airplanes. Obviously, with this hazardous compound saturating the fabric covering, which itself is combustible, a very hazardous material is produced. This hazard is the outstanding one and the greatest factor contributing to the spread of fire in airplane hangars. The hazard may be doubly great if the dope is applied to the planes in the hangar. In its application, the dope must necessarily be thinned with a liquid which is very volatile, and the material usually used is amyl acetate or some other liquid of equally great hazard. These thinners will flash below ordinary temperatures. In addition, then, to the hazard of the pyroxylin dope, there is the hazard of flammable vapors when the painting is carried on in the hangar.

Another hazard of the plane is that of the gasoline contained in the tanks. The gasoline easily vaporizes and may produce an explosive mixture. In the event of fire the exploding tanks would drench the surroundings with burning gasoline and spread the fire throughout the hangar.

It is readily seen that with these conditions prevailing, the greatest care must be exercised to prevent fires, and adequate first aid equipment must be provided to check fires in their incipiency. In considering the hazards of the processes and operations carried on in hangars, it is well to study the fire record of this type of risk. The "Quarterly" of the National Fire Protection Association, dated April, 1930, gives the following table of causes reported in forty hangar fires from January 1, 1928 to April 1, 1930:

Ignition of Flammable Vapors		13
Explosion, source unknown	4	
Doping operations	2	
Fires in Engines	2	
Oil burner	1	
Washing plane with gasoline	1	
Flames from exhaust of engine	1	
Explosion of gas heater	1	
Ignition by blow torch	1	
Heating Appliances		5
Overheated furnace or stove	4	
Coal stove tipped over	1	
Smoking		4
Welding Operations		3
Welding gasoline tank	1	
Acetylene torch set fire to fabric of plane	1	
Acetylene torch ignited barrel of lacquer	1	
Miscellaneous		5
Supposed short circuit	2	
Fire in gasoline torch	1	
Lightning	1	
Children and matches	1	
Supposed Incendiary		2
Unknown		8
Total		40

To quote from the "Quarterly":

"This record of forty fires includes a total of one hundred and fifty-four planes damaged or destroyed. This is an average of four per fire. The total loss in thirty-four fires, where a loss was given, amounts to $2,400,000. This is an average of over $70,000 per fire, which is very great, even allowing for the fact that some of the reported losses may be high.

"The reason for this record of

(*Continued on page 110*)

Tests were conducted at the Newark City Airport and the value of floor sprinklers was proved.

Electric Conduction in Metals

By **J. S. Thompson, Ph.D.**

Assistant Professor of Physics

IN PROBLEMS dealing with electrical networks, where Ohm's law or Kirchoff's development of this law are applicable, the electrical current may be regarded as a weightless incompressible fluid in motion. The familiar hydraulic analogy substitutes the height of water in a reservoir for electric pressure; also the flow of water in cubic feet per second and the viscous retarding forces in the pipe for the electric current and resistance, respectively. Conductivity is defined as the property of a substance by virtue of which all its parts tend to come to the same pressure in much the same way that a liquid is said to seek its own level. This equalization of the pressure is achieved by the fluid flow. If the height of the reservoir is maintained or a source of electric pressure held constant, there is a current flow which strives to bring about equality in pressure. When an electrical current flows through a conductor, there is no accumulation of electrical substance at any point; this behavior is analogous to that of water which is practically incompressible. The proportionality between current and pressure is similar to Ohm's law for electric conductors. Here the analogy ceases and with the exception of a rough approximation of the heating effect in conductors, all of the various phenomena of the electric current are left unaccounted for.

Many years ago it was shown by Rowland that static electric charges in motion produced effects which were identical with those of the electric current. His experiments, which were concerned with the magnetic effects of moving charges, bridged the gap between static and current electricity and showed them to be different manifestations of the same thing. Subsequent work has shown that all electric charges are made up of discrete units. Thus the problem of conduction becomes definitely linked with the properties and behavior of these electric corpuscles, or electrons.

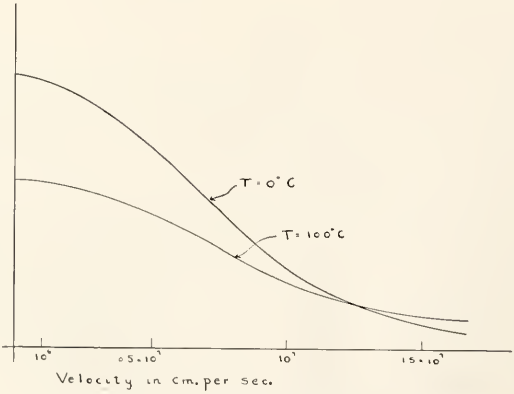


Fig. 1. This graph shows the velocity distribution in electron gas at 0° and 100° C., according to the electron theory.

Development of the electron theory came about chiefly in the study of electric currents in electrolytes and in rarified gases. Here it became possible to study the behavior of these electric atoms free from disturbing effects of collisions with molecules, or to control these collisions at will. The results of countless experiments have led to the conclusion that all matter is composed of electrical atoms, the electron and proton. The electron is the smallest atom of negative electricity; its charge, mass, and radius have been accurately measured and it is found to be a constituent of all matter. The positive counterpart of the electron is the proton, the fundamental unit of positive electricity, the charge of which is identical with that of the electron but whose mass is some 1,840 times as large. The chemical atom is built from these electrical units combined in such a way as to make the finished product neutral. One very successful picture of the atom portrays a positive nucleus made up of electrons and protons, arranged together so as to give a net positive charge, about which are revolving electrons in definitely determined elliptical orbits. There are as many electron planets as there are resultant positive charge units on the nucleus or sun. Hydrogen, the lightest known atom, has a nucleus of one proton and one electron orbit; Uranium, the heaviest, has 91 electrons in its planetary system. Most of the mass of the atom resides in the nucleus due to the preponderance of mass of the protons. Experimental determinations of the atomic radii show that distances between nucleus and electrons in the atom is of the order of 10,000 times as great as the electron radius. This means that the atom consists mostly of space and that matter is probably extremely porous.

On this picture the various chemical elements are distinguished by different numbers and arrangements of the electrons and protons in the atom. In general, the chemical properties depend only on the number of planetary electrons and not at all

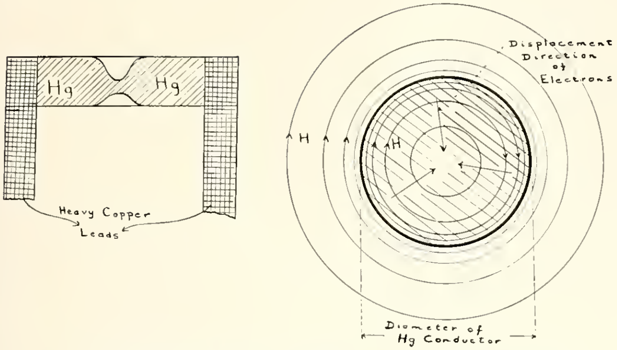


Fig. 2. Above at the left is shown a demonstration of the "Pinch Effect" of electron friction. At the right another interpretation of it is pictured.

on the mass of the atom. That this is true has been shown in the existence of different masses. For example, mercury has atoms with five different masses, but all possess the chemical property of mercury and can only be separated by special methods of analysis.

There is another class of electrical carriers which are called ions; these ions are simply atoms or molecules which have lost or gained one or more positive or negative charges. If a sufficiently high electric pressure is impressed across ordinary air, one or more electrons will be driven from the oxygen and nitrogen atoms so that the residue carries a resultant positive charge. This residue is thus a positive ion. Negative ions are formed by the attachment of electrons to the atom. It is the movement of ions that gives the current in electrolytes and in some crystals as well as in gases.

The advent of the electron theory gave a new interpretation of the electric current. Motion of the electrons, protons, or ions or a combination of these, replace the flow of the "electrical fluid" and the total charge transported by this means per second is the current. It becomes possible now to calculate quantitatively from the structure of the conductor and the constants of the moving charges the currents to be expected and how they will behave under various conditions. The object of this brief sketch is to outline some results of the application of the electron theory to the study of currents in metals, together with the difficulties which arise and some of the more recent attempts at their solution.

Although the problem of conduction in metals is probably the oldest in the study of electric currents, it has resisted solution most strongly and until very recently there has been no adequate theory of this phenomenon. When the current picture was changed from Maxwell's imponderable fluid to the flow of discrete atoms of electricity, no change was necessitated in the ordinary laws of networks so that any difficulties in the new electron theory were not felt in practical engineering applications. However, new problems were arising before the engineer which involved discharges in gases and currents in vacuo and in electrolytes, all of which were yielding remarkably well to the electron theory. The great successes in these new problems made it imperative that the case of metallic conduction be fitted into the scheme.

Briefly, the electron theory has given the following picture of a current flowing in a metal conductor. The metal, in general, consists of a lattice structure, the units of which are the atoms or ions of the solid. In addition, there exist in the metal numbers of free electrons which move about in the spaces between the ions like molecules of a gas in the kinetic theory. These electrons, which were at one time derived from the atoms, possess random velocities due to their collision with the ions. When equilibrium is established, some of these velocities are large and some small and the probability of a velocity being in one direction is equal to that of any other, but all are grouped about a sort of average velocity which depends on the temperature of the metal. This sort of arrangement is called Maxwellian and a typical distribution is shown in Fig. I. In the absence of an electrical pressure, these electrons transport just as much charge in one direction as in another so that no current exists on a large scale in the conductor. If a source of electromotive force is impressed across a portion of the metal, there is a draft of electrons in the direction of pressure which is superimposed on their thermal motion. It is this resultant velocity of drift that is the electrical current. No "electricity" is manufactured by the battery or generator, but the free electrons already existing in the circuit are set in motion and thus produce the effects of the current. That the electrons and not the ions are carriers of the charge has been substantiated by experiment—no chemical changes are found in conductors after long service and under heavy current loads, showing that the crystal structure of the metal is retained and that the ions remain in position.

The resistance offered to the flow of the electrons is due to their encounters with the atom residues or ions which are rigidly fixed in position. If it were not for these collisions, the electrons

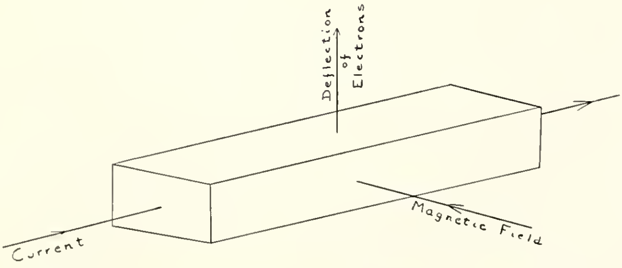


Fig. 3. Here is pictured the "Hall Effect" which is obtained when a bar of metal in which a current is flowing is placed in a transverse magnetic field.

would gain momentum indefinitely under the impressed electromotive force. Loss of momentum at collisions is imparted to the ions and these are probably set into vibration about their mean positions without contributing to the current. This increase in energy of the more massive ions accounts for Joule's law of increase in temperature with current and resistance.

A simple derivation of the current based on the electron theory shows that Ohm's law of proportionality between current and pressure should be expected. Also the experimental fact that the resistance is, roughly speaking, proportional to the absolute temperature is in agreement with the theory for all except the lowest temperatures.

Results obtained from the study of the reflecting power of metals show that there are approximately as many free electrons in a metal as there are atoms, that is, about 10^{18} per cubic millimeter. From the known value of the electronic charge it is found that to convey a current of one ampere, 6.3×10^{18} electrons must pass any cross-section on a conductor per second. Thus in a wire one square millimeter in cross-section, there are 10^{18} electrons per millimeter, and for a current of one ampere the average velocity of drift is a little over one centimeter per second. There are a number of striking experiments which bear out the picture created by the electron theory. The "Pinch Effect" shows the action of the electrons on the ions of the metal when these ions are more free to move. In Fig. 2 is shown a shallow pipe filled with mercury, the ends of which are in contact with two heavy copper bars which serve as current leads. When the current through the mercury is of the order of 1000 amperes, the conductor becomes constricted as shown. Another interpretation is also shown in Fig. 2. Here the mercury conductor is shown in cross-section and the electrons are approaching the reader from below, surrounded by the concentric circular lines of magnetic flux running in a clockwise direction around the current. The electrons moving perpendicularly to the magnetic lines are deflected radially toward the center. Under the influence of this radial force the electrons now in their collisions drag along the mobile mercury atoms, thus producing the constriction.

The Hall effect also receives a partial explanation under the electron theory. This effect is obtained when a bar of metal is placed in a transverse magnetic field; when a current flows in the bar perpendicular to the field there is found to be a small electrical pressure across the bar at right angles to both the current and the field. The relations are show in Fig. 3. Here, as in the Pinch effect, the electrons are deflected under the influence of the magnetic field, receiving an upward force; since they are prevented from moving out of the bar by the attractions of the positive ions left in position, a difference of potential due to the separation of the charges is set up across the bar as shown. This is satisfactory as far as it goes but fails completely to show why the force is reversed in some metals.

One of the chief successes of the old electron theory was its perdiction of the relation of thermal to electrical conductivity. As is well known, metals which are good electrical conductors are also good conductors of heat. This ratio is constant for a given temperature and for most metals not so very different from that calculated. Also, since the electrical conductivity is inversely proportional to the temperature and the thermal conductivity nearly independent of it, we should expect the ratio to be proportional to the absolute temperature. Thus both these facts may be said to support the electron theory.

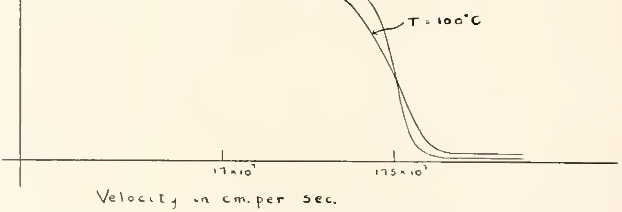


Fig. 4. This graph shows the velocity distribution in electron gas at 0° and 100° C., according to wave mechanics.

Although the theory outlined above gives a picture of current flow, predicts Ohm's law for steady currents, and gives a more or less qualitative interpretation of other current phenomena, it is wholly inadequate in explaining many properties of metals, particularly at low temperatures. In the neighborhood of absolute zero the resistance of most metals is no longer proportional to temperature as predicted by the simple electron theory, but to a much higher power of it. In other words, in this region the resistance falls very rapidly with the temperature. In the cases of some metals, notably lead, tin, and mercury, the resistance practically vanishes at a few degrees above the absolute zero; for mercury the resistance becomes zero at 4.3°, the temperature of liquid helium. It has been found that a current, started by magnetic induction in a closed coil of wire in the super conducting state, maintained itself constant to within 1 part in 20,000 in the interval of one hour. This result confirms the vanishing of the resistance to less than $1/10^{12}$ of its value at 0° C., and would indicate that the electrons had mean free paths of many times the circumference of the wire. Other metals also behave in a anomalous way at these low temperatures. For example, the resistance of plati-

(*Continued on page 106*)

Aircraft Engines

By Daniel Roesch, '04

Professor of Automotive Engineering

MUCH thought has been given in recent years to "cleaning up" the design of aircraft and the reduction of "drag." The radial air cooled engine has been subject to justifiable criticism of the increased drag due to larger frontal area as compared to the in-line engine. The following comments are based upon data in N. A. C. A. Report No. 314, entitled "Drag and Cooling with Various Forms of Cowling for a Whirlwind Radial Air-cooled Engine, by Fred E. Weick—II." A standard 9-cylinder Wright Whirlwind engine of 200 H.P. at 1900 r.p.m. was used with an open cock-pit fuselage similar to that of a Vought UO-1. Cylinder temperatures were observed with the aid of thermocouples on No. 1 cylinder and 20 others on various parts of the engine. In the cooling tests the engine was operated at 80 M.P.H. until the temperatures were substantially constant, and any cowling not giving approximately the same cooling as the uncowled engine was modified for this effect. Tests were made with various cowling; spinner and engine alone showing important drag reduction for certain constructions.

The drag of the open cock-pit fuselage (without supports or landing gear) at an air speed of 100 M.P.H. are given in Table 1 (a).

The power saving by a reduction of 68 pounds at 100 M.P.H. air speed is equal to about 18.2 thrust H.P. which may be used to increase cruising radius, life of engine, pay load, air speed, etc.

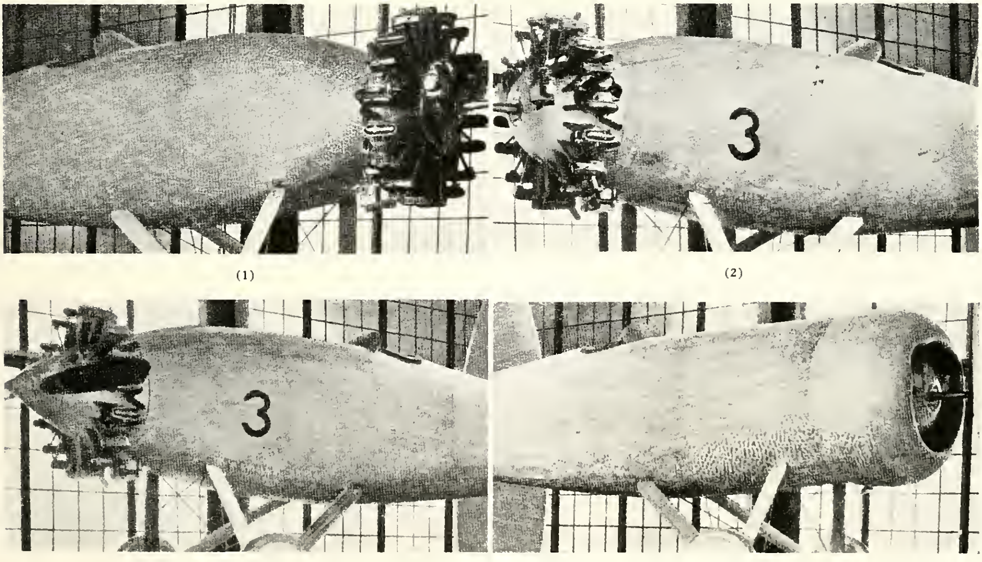
The drag results obtained with three nacelles show even greater gains obtained by cowling. In general the gains are greater when cowling engines in front of smaller bodies. This statement is in accordance with the test results obtained for cowling of the larger bodies of cabin fuselage which show less gains than those of the open cock-pit fuselages.

The test results at 100 M.P.H. for the nacelles when mounting the same engines are in Table 1 (b).

It is noted that the conventional nacelle has 23 lb. less drag than the engine alone. The latter has just over one-half the drag of a flat disc of the same outside diameter—45 inches. The reduction of 112 pounds drag at 100 miles per hour air speed corresponds to 30 thrust H.P. or nearly 40 B.H.P. of the engine.

The influence of the size of the bodies back of the engine is shown by gains in the percentage of reduction of drag of the uncowled engine of 59, 69, and 76 per cent for the cabin fuselage No. 10, open cock-pit fuselage No. 4, and the nacelle No. 14, respectively.

The above data, as well as many other instances in N. A. C. A. reports and the commercial examples of reducing avoidable losses, illustrate the economic possibilities of good engineering. Of major interest is the recent development of high temperature cooling wherein



(1) (2)

(3) (4)

Fig. 1. The views above show four different cowling effects, each of which was put under test to determine the drag.

TABLE 1 (a)

Cowling (See Fig. 1)	Fusselage and Engine Drag, Pounds	Reduction from Uncowled engine, Pounds
No. 1. Engine Uncowled	141	0
No. 2. No Spinner	136	5
No. 3. Spinner	132	9
No. 4. Complete Cowling	73	68
No. 1. Engine Removed and Nose Rounded	42	99
No. 2. Engine Removed and Cylinder Holes Closed	42	99
No. 1. Engine and Windshield Removed and Cockpit Covered	28	113

TABLE 1 (b)

Nacelle	Drag Pounds	Reduction Pounds
No. 12. Engine alone Uncowled	178	0
No. 13. Conventional Cowling	155	23
No. 14. Complete Cowling	43	135

liquid cooled engines use ethylene, glycol, or other suitable high boiling point liquids in place of water. One direct benefit is the reduction of radiator size based on radiation varying as the 4th power of mean temperature difference. Increasing the jacket water temperatures to 300 degrees or more permit a drastic reduction in radiator frontal area and a corresponding reduction in this drag. The size of the radiator is so small that it is proposed in some cases to use the engine jackets with slight finning to replace the radiator.

The advantage of "cleaning up" is illustrated by recently published views of Col. Lindbergh's new Lockhead low wing monoplane. The design incorporates a favorable blending of engine and cabin into a stream-line structure and a landing gear which is retractable into the wings.

Cylinder Temperatures

Records of cylinder temperatures of the modern air cooled radial engine have been reported in N. A. C. A. Technical Note No. 328 with interesting data from a Wright J-5 engine. As reported elsewhere in this article, this engine operates at considerably higher temperatures than later improved models of the radial air-cooled engine made by the same manufacturer. It has long been known that increasing the mixture ratio will often lower the cylinder temperatures to a better operating condition. The excess fuel will act as a coolant, with improved power and anti-knock performance of the engine. The temperature of cylinders shielded by magnetos and those unshielded is shown in the accompanying curve sheet, Fig. No. 3, for one set of conditions at various rates of fuel consumption. The reduction of cylinder temperatures is striking for the unshielded cylinder and in all cases for the richer mixtures. The mixture ratio for greatest power is at about 0.9 of a pound per B.H.P. per hour. The 0.7 of a pound per B.H.P. per hour fuel consumption corresponds to about 9 per cent reduction in power.

Fuel Requirements

The fuel requirements for an aircraft engine has been given in an S. A. E. Paper by Mr. S. D. Heron from the Army Air Corps viewpoint under the following headings:

(1) Anti-knock value.
(2) Volatility.
(3) Vapor-locking and starting properties.
(4) Gum.
(5) Available fuels and anti-knocks.

The most important property is the anti-knock value as this can easily determine the failure or success of an engine, especially of the high-duty military type.

The conventional civil and military aviation engines operate satisfactorily on 70-75 octane value fuel except fuel having high tempera-

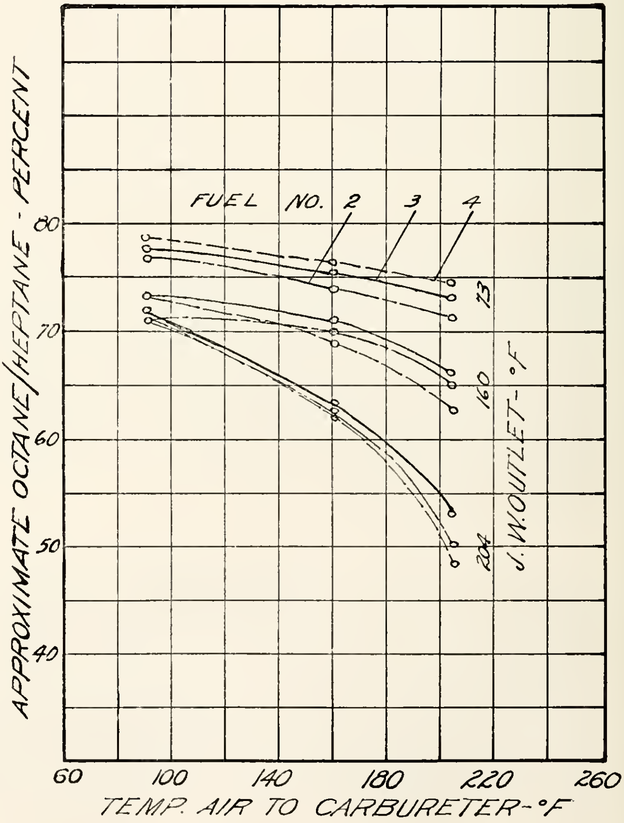


Fig. 2. This graph shows the effect of temperature on the anti-knock values of several fuels.

TABLE NO. 2

Nature of Aircraft Accidents in Percentages

Classification	*Number of Accidents and Percentages*		
	Army and Navy 1432	Civil 1400	Total 2832
A—Collisions in full flight with other aircraft	2.44	0.64	1.55
B—Collisions in full flight, objects not aircraft	3.00	8.14	5.54
C—Spins or stalls after engine failure	1.68	5.14	3.39
D—Spins or stalls without engine failure	8.31	24.07	16.10
E—Forced Landings	25.98	20.71	23.88
F—Landing accidents	32.60	17.50	25.14
G—Take-off accidents	8.17	10.93	9.53
H—Taxying accidents	5.45	2.29	3.88
I—Fire in the air	1.33	0.93	1.13
J—Carrier, platform, or arresting gear	5.17	0.00	2.61
K—Launching gear accidents	1.05	0.00	0.54
N—Structural failure	1.61	3.00	2.30
X—Miscellaneous	2.09	4.86	3.46
Y—Indeterminate and doubtful	1.12	1.79	1.45

TABLE NO. 3

Causes of Aircraft Accidents in Percentages

Classification	Army and Navy 1434	Civil 1400	Total 2834
Pilot's error of judgment	11.44	10.22	10.83
Pilot's poor technique	28.88	29.61	29.25
Pilot's disobedience of orders	1.62	3.36	2.48
Pilot's careless or negligence	6.59	7.47	7.02
Pilot's miscellaneous errors	0.07	0.53	0.30
Errors of supervisory or other personnel	3.01	2.32	2.67
Power plant failure	19.02	15.75	17.41
Failure of landing gear	6.34	1.75	4.07
Failure of wheels, tires or brakes	2.73	0.52	1.64
Structural failure of other parts	3.61	3.25	3.43
Handling qualities	1.34	0.34	0.85
Instruments	0.02	0.00	0.01
Launching devices	0.31	0.00	0.16
Arresting devices	0.76	0.00	0.38
Weather	3.44	6.92	5.16
Darkness	0.18	0.96	0.56
Airport or Terrain	8.47	5.60	7.06
Misc., undetermined and doubtful	2.17	11.40	6.72

ture coefficients of anti-knock values. These values correspond approximately to commercial premium motor car fuels, although these are tested at lower temperatures. The recently issued tentative specifications No. Y-3557 of the Air Corps specify 300 degrees jacket temperature. This serves to correlate test conditions with operating conditions and avoid unreliable information on the operating anti-knock characteristics of fuels when selection is based on test results made at a lower operating temperature. These tests may rate fuels equally at some low operating temperature and not truly represent relative anti-knock values at higher temperatures. The chart Fig. 2, plotted from the results of an investigation in the A. I. T. laboratories, shows the marked and non-uniform variation of the anti-knock value of fuels with temperature. Fuel No. 4 was a 40% benzol blend showing the greatest change of anti-knock with temperature. An arbitrary temperature coefficient of anti-knock is 13.1 for the benzol as compared to 10.2 for No. 2 and 9.8 for No. 3 fuels. The temperature ranges in these tests were considerably smaller than those met with in airplane work. The air corps have a tentative specification of 87 Octane and 13 Heptane for high-performance engines of the ground boosted high-compression and high-cylinder-temperature types.

The volatility and vapor-locking tendencies are provided for in the tentative specifications Y-3557 by limits of 144 to 162 degrees F. for the 10% point of the evaporation curve. It is undesirable also to reduce the lower limit because of possible boiling in the tank of supercharged airplanes which may reach an altitude of 30,000 ft. in 20 minutes and have very little fuel temperature reduction.

Gum is limited to 3 mg. by copper dish test and there are other restrictions of gum stability with age. The anti-knock values of 87 Octane can best be supplied by using tetraethyl lead and aromatics with the consideration that benzol becomes relatively ineffective at high cylinder temperatures and additions of even 20% sometimes become troublesome for freezing temperatures. "Knock Values of Aviation Fuels" by E. E. Aldrim of the Standard Oil Co. of N. J. was the subject of a very instructive paper given at the 18th National Aeronautic meeting of the Society of Automotive Engineers at Chicago on August 27, 1930. In a graph of fuels which are approximately suited for various engines, there is shown 68% Octane percentage equivalent fuels as being at least permissible for use in the Curtiss D-12, Whirlwind J-5, Liberty L-12, Conqueror 5.8 compression, and Challenger 4.9

(*Continued on page 108*)

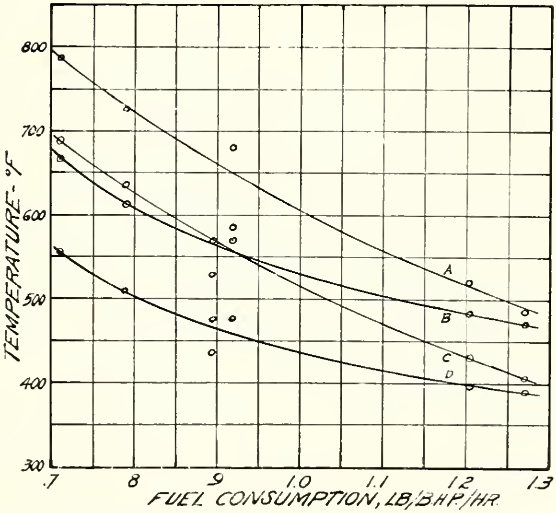


Fig. 3. This shows the effect of fuel consumption on the temperature of the spark-plug bosses of a cylinder that is shielded by a magneto as compared with the average temperature of the spark plug bosses on unshielded cylinders. (A) Rear, cylinder No. 3. (B) Rear, average for unshielded cylinders. (C) Front, cylinder No. 3. (D) Front, average for unshielded cylinders.

ENGINEERING NEWS

Energy From the Atmosphere

The French are very fond of ingenious and novel devices for securing additional sources of energy. As an example, we may take the recent experiments in securing energy from differences in temperatures existing at the bottom and at the surface of the sea.

Now another Frenchman has revealed a source of energy by suggesting a new use for the "captive balloon," namely, the securing and utilizing of atmospheric electricity. Scientific experiments over a long period of years have shown quite definitely that electric potential increases as we pass from ground level to altitudes. The voltage difference between two levels a thousand yards apart is about 30,000 volts, although the amperage is very small, yet not negligible.

Experiments performed on Mount Blanc have showed that enough energy exists to light several incandescent lamps by means of this principle. Neon lamps have been illuminated by the same idea. A captive balloon is suspended in air at a great height. It is equipped with metallic rings and metallic electricity collectors interconnected. An insulated wire is used to transfer the energy down to earth.

As yet we cannot predict the outcome of this bit of engineering research. Will it prove useful in the future?

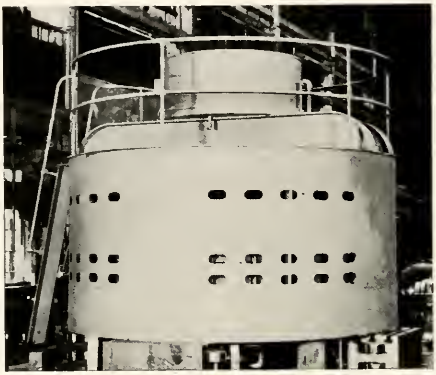
A Quick Frozen Fruit Juice

A quick-frozen mixture of California and Florida fruit juices, frozen at the point of production and distributed direct to the consumer in glass bottles, now accompanies the morning milk bottle.

The juice is shipped in frozen form in refrigerator cars to the distributing station in the large 6-gallon cans in which it has been frozen. A crusher process transforms it into a snowflake slush form, and it is then agitated to a consistency sufficient for bottling, automatically capped and placed in a cold room ready for delivery.

700 H.P. Vertical Motors Designed

Four vertical synchronous motors, designed as three speed machines, have recently been built and shipped. They will be used to drive propeller-type pumps which are employed to circulate large quantities of water at low head. The present motors are built for two-speed operation with provision made for adding an additional speed unit at some later date. Both motors are rated at 700 h.p. at 277 R.P.M. and 350 h.p. at 138 R.P.M., and will be in the form of a separate armature and rotor.


This view is of a two-speed vertical synchronous motor which has just been placed in service. Provision is made for adding an additional speed unit at a later date.

Because of the characteristics of the pumps, the motors were designed with extremely high torque. The starting sequence is automatic with the motor control interlocked with the pump valve motor control. The desired operating speed is obtained by selector push button control. The motor is always started on the low speed winding regardless of the operating speed desired. If the high or intermediate speed is required, the transfer to the correct winding is automatically made at the proper time. The motors are started on full line voltage, the various steps in control operation being accomplished through definite time relays. Because of possible emergency operating conditions, the motors were designed to hold in step with a 25 per cent voltage drop when another unit is being started.

Caustic Soda Shipping

The problem of shipping pure caustic soda to rayon and soap manufacturers by freight has recently been solved by the construction of nickel-clad tank cars. Although it is entirely possible for manufacturers to produce commercial NaOH with a contamination of iron not exceeding 0.02 per cent, the task of delivering it in this pure state was exceedingly difficult to dealers who shipped carload quantities.

The shipping of caustic soda in iron cars seriously contaminated the substance at times to such an extent that the delivered substance contained over 0.09 per cent of iron. When buyers specified a limit of 0.08 per cent of iron content, the caustic soda had to be shipped in fused solids. The cost of dehydrating and handling the solid NaOH raised the expense greatly.

Through the use of the nickel-clad tank car it is possible to ship the caustic soda without facing the danger of having the product contaminated. The nickel-clad steel plates have the same corrosion-resisting properties as pure nickel. The steel plates of the tanks are bonded to the nickel with pure nickel rivets. The heater coils, likewise, are seamless nickel tubing. The physical constants of nickel and steel, particularly their similar coefficients of expansion, are such as to make these two materials well suited to the production of rolled plates, enabling the car builders to exert no added effort in building the tanks.

New Refrigerant Discovered

A new cooling gas for refrigerators may make the old time ice box an antique for evermore.

The new gas is non-poisonous, for quantities of it may be breathed without the slightest ill effects. It is also non-inflammable. Its technical name is "fleuro - chloromethane."

Besides its household use, it may have other important applications because of its highly desirable engineering qualities.

Spark Timing Control

Recently a new spark timing control has been found which is more successful than the present best automatic carburetor control. This new device employs the pressures occurring in the engine cylinder.

It has been the general theory that the proper timing of the spark depends mainly upon engine speed. However, research work has shown that other factors in operation, such as mixture conditions, torque load, local temperature conditions, etc., also have an effect on the best spark timing.

A central cylinder is used in this latest spark timing device. It is placed in communication with the engine cylinder a few degrees after dead center on every explosion stroke, so that the pressure in that end of the control cylinder corresponds to the pressure in the power cylinder at this point of the cycle. Similarly, the other end of the control cylinder is placed in communication with the engine cylinder about 50 degrees past top dead center on the power stroke, and the pressure in this end of the control cylinder, therefore, corresponds to the pressure in the power cylinder 50 degrees from the beginning of the power stroke. Communication between the engine cylinder and the two ends of the control cylinder is established by means of small poppet valves which are opened by cams on the shaft driving the ignition unit, which, of course, is a half-time shaft.

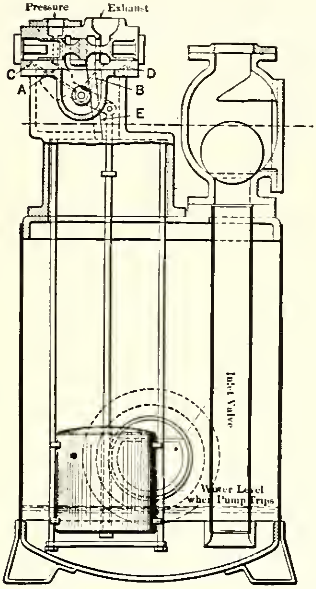
Should the peak pressure in the engine cylinder occur too early during the power stroke—which would indicate too great an advance of the spark—the piston in the control cylinder is forced away from that end which communicates with the power cylinder early in the power stroke, thus retarding the spark. If it occurs too late in the power stroke or too far from the top dead center position, the control piston is moved in the opposite direction, so that the spark is advanced.

Many of the said defects are negligible in the operation of this device. The linking mechanism must be of high quality so as to obtain the best results. The cylinder to which the control device is connected may not represent engine conditions. One cylinder is found to be sufficient, although others may be interconnected in the more expensive installations. Should there be a miss in the cylinder to which the valve is connected, the spark will be fully retarded.

The Air Lift Pump

It is sometimes quite undesirable to use pumps having pistons and vanes for the conveying of liquid materials containing solids, such as mud, gravel, and organic materials, as there is a tendency toward "stoppage" of apparatus.

In recent years the air-lift pump, therefore, has come to the fore wherever the above type of pumping is required. The theory of the pump is comparatively simple. The operation depends on mixing sufficient air with the liquid in the discharge pipe, thereby making the latter lighter than the liquid in the supply pipe. A differential pressure is set up and the liquid in the discharge pipe rises in consequence. To obtain a large pressure requires considerable submergence, which depends on the amount of the lift. The size of the discharge pipe varies with the height of lift.



Here is shown a single cylinder float-operated pump used in connection with the air lift.

Although the mechanical efficiency of air-lift pumps is low, their absolute dependability and "all-round freedom" from trouble make them indispensable, particularly where rough operating conditions prevail. There is only one feature that must be watched and that is the supply of compressed air for the aeration. However, with the modern automatic equipment employed, there is not much danger of failure.

Paragutta—The New Insulation

Formerly deep sea cables were employed exclusively for telegraph purposes, but in recent years there has been an increasing use of this type of cable for telephone service. Telephonic communication requires cables of very much superior transmission quality to that needed for the telegraph. At the higher frequencies of voice transmission, the energy losses in the insulating material become a serious factor and a radical improvement in submarine insulation is called for. As a result of an investigation for a better material, paragutta has been developed.

The principal constituents of paragutta are deproteinized rubber and purified gutta hydrocarbon. Especially treated hydrocarbon or montan waxes may also be added as a third constituent to modify mechanical properties and reduce cost. The proportion of these substances may be varied over a wide range to achieve the desired characteristics, but, in general, rubber and gutta are used in about equal proportions and purified montan wax may be added up to about 40 per cent. Superior electrical properties, however, result from the use of hydrocarbon waxes, which may be added in amounts up to about 20 per cent. By the proper blending of these materials, a thermoplastic insulation is obtained which closely approximates gutta percha in mechanical properties and is fully its equal as to electrical stability in water.

The electrical properties of paragutta depend upon the particular composition chosen, the quality of the raw materials, and the care exercised in processing them. For long telephone cable insulation, it is necessary to exercise the utmost care to obtain a material having dielectric constant and specific conductance values sufficiently low to reduce to the minimum its effect on the attenuation. On the other hand, for ordinary telegraph cables these values are less critical and it may be advantageous to modify the practice for purposes of economy. From representative values of a superior grade of paragutta and typical cable gutta percha, the dielectric constant of the former is 20 per cent lower than that of the latter. The specific conductance of paragutta is one-thirtieth that of ordinary cable gutta percha under sea-bottom conditions. These two factors are a measure of the material's superiority in its use.

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

VOLUME XXII — MARCH, 1931 — NUMBER 3

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Make The Armour Engineer the best technical college publication in the country.

> *Men must play fair; there must be no shirking; success can come only to the player who "hits the line hard".*
> —*Theodore Roosevelt.*

THE ENGINEER'S DUTY to the public has become vitally important. Within the last decade, highly technical public enterprises and government operations have increased rapidly in number and variety. Municipal ownership of transportation facilities and public control of power and light projects have brought with them numerous problems which the engineer alone is qualified to analyze.

It is noteworthy, then, that in only an astonishingly few instances has his unbiased information been allowed to reach the public, upon whose opinion the ultimate decision must rest. Without adequate and accurate knowledge of the factors involved, the citizenry has very often been the victim of the political aims and theories of a small group behind the project. Roseate promises and golden prophecies have been used to guide the lay inclination into what has many times proved costly and woefully unsound. And yet, the engineer's conclusions based on complete and detailed investigation of the proposition before its inauguration have nearly always predicted such results. The public was simply not allowed an opportunity to reach an accurate understanding of the problem.

In discussing this situation, William S. Lee, president of the A. I. E. E., said: "It is the engineer's duty to the public, in these days when there are so many public and quasi-public operations, to make available his judgment and advice so that the people at large may have the advantage of it in arriving at intelligent conclusions in these matters."

The duty is not an easy one; political influence, pressure of a prejudiced press, the machinations of certain individuals, and other great American forces may be lined up against the engineer's efforts. Yet so grave is the responsibility that it must be undertaken at any cost.

IN THIS DAY AND AGE OF progress and swiftly changing times and ideas, should a zoning ordinance or building code, passed in 1923, be considered obsolete and "out of date"? This question has been one of much controversy and discussion of late in Chicago and many of the larger cities of America. One faction cries that as the times and ideas change so should the building ordinances and zoning rules be altered. The other group derides any suggestions for a change on the basis that the present skyline is beautiful, and that higher buildings and sky-scraping towers are not necessary and would add little, if any, to the beauty of the present skyline.

Much has been said and very little done about the change in the last year in Chicago. Matters were recently brought to a temporary head when an alderman of the city council proposed an amendment to the building code to permit an increase in the dimensions of the towers in the downtown section of the city.

On first thought one might be led to believe such an amendment to be of great value, but with due consideration the aspect changes a great deal. Followers of the amendment have said that in as much as the present skyline of towers and spires is beautiful, an increase in the size and height would make it more impressive and beautiful. In response to such an argument one might add that there is a definite limit to be drawn between beauty and practicability. Such an amendment appears as a concession to prospective builders and a discrimination against owners of buildings recently erected under existing restrictions. The fire hazard of such skyscrapers should also be given consideration. Certainly to build larger towers and higher buildings would be to greatly decrease the efficiency of fighting a fire in the upper stories of a structure.

The Chicago City Council, in the light of such a controversy, has consulted architects, builders, and property owners affected by the proposal. Such men are best qualified to pass on such an amendment. Few, among the many consulted, have expressed sympathy with the proposal, while some have already gone definitely on record as opposed to it. The present zoning ordinance has worked well, and unfair special privileges under it have met with effective legal resistance.

Then, also, the present skyline of the Chicago business district is too beautiful to be trusted to alterations. To those Chicagoans who every day travel in and about the city, the beauty of such a skyline is taken as a matter of fact. But to the visitor, Chicago's present skyline appears impressive—a beauty not to be experienced in any other city. It is true that individually many of Chicago's towers may be lacking in architectural charm, but on the whole as they are silhouetted against the sky they present a mass of stone, concrete, and steel which is unrivaled in other American cities. In view of all such arguments and after due consideration of the present spirit of progress, it seems more than logical that the skyline should remain as it now stands, until such time as it becomes impracticable.

IS AIRPLANE TRAVEL BEcoming safer and surer, or will land and water always surpass the air in reliability as a means of travel? Here is a question that cannot be answered directly. Many people claim in certain arguments given by them that air travel either is or is not becoming constantly more and more safe, but statistics are gradually being compiled which eventually will take the problem out of the argumentative field. Even now, there are a few persons who are continually in touch with the aviation industry through commercial, government, or student contacts, that are qualified to throw some light on the disputed point.

THE KENTUCKIANS

Seer of our mountains rude and strong,
Prophet of the children of our hills,
Where justice knows no law, but strikes and kills,
And shows no mercy, palliates no wrong.
Clean and pure the highland air we breathe
Through the rhododendron purpled page,
Unfolding visions of a primal age
Ere the vengeful blade men learned to sheathe.
Be thou the prophet of our sensuous plain;
Strength of oak into our veins infuse;
Virile honesty of heart and brain—
Our languid blood with ruddier heat suffuse
Till welding fire of kindred love shall flame
To make "Kentuckians" a peerless name.

—F. W. Everhardt.

Foremost among such men we find the name of C. M. Young, assistant secretary of aeronautics, who only recently submitted a report to President Hoover on the progress of commercial aviation in the last eighteen months. From the article we learn that while the aviation industry needs a great deal more aid and encouragement from the government, nevertheless, its growth has been unusually good considering the rather adverse conditions which handicap the industry. The importance of aviation in various instances is great enough to warrant the aid of all departments.

In times of peace, the service the airplane renders is tremendous. A few statistics will show that the people of the country are fast awakening to the importance and serviceability of the airplane. It has been pointed out that in 1930 an average of one hundred thousand miles of scheduled service was flown in this country every twenty-four hours. This total does not include the miles flown by students, technicians, sportsmen, and others or even the eighteen thousand miles flown daily on regular routes between the United States and Canada and Latin America. The prediction has already been made that in the current year more than two hundred thousand persons will be carried by the air services in the Uited States. Already our large railroads have recognized the practicability and reliability of air travel, even going so far as to incorporate transcontinental trips which are made up of a pleasing variation of daylight travel by plane and night travel by train.

Gradually the feeling that air travel is relatively safe and is steadily growing safer is becoming more and more apparent among our civilian population. A recent report, not Mr. Young's however, shows that the rate of fatal accidents is now about one for each five thousand passengers carried on scheduled air lines. With short pleasure flights we see that the risk is even smaller, provided the planes are properly operated by licensed pilots. Do not such statistics compare favorably with our everyday accounts of scores and scores of fatalities through automobile, train, and motor bus accidents?

In the past year the reliability of the airplane was demonstrated as never before in the many endurance flights which were successful, setting records which seem almost unbelievable. Therefore, it seems hardly necessary to state that the future of aviation seems brighter than ever. Developments will continue which will make airplane travel less and less of a hazard.

As the records continue to be set, as the trans-oceanic flyers continue to gain laurels, and as pilots continue to be acclaimed for their deeds, we should not forget the reliable, unheralded persons who are, so to speak, "behind the scenes", giving their unceasing and untiring efforts to the progress of such an industry as aviation.

COLLEGE NOTES

Our Varsity Captains

Indoor Track

Frank M. James, '31

The indoor track team, the most successful of our major teams last year, is now engaged in competition with Frank M. James piloting the squad. Unfortunately, injury and sickness have played havoc with the team during the past three weeks. The loss of three "high lights" of the squad during this time has developed considerable worry as to further progress. Recent indications show that two of these men will be back again in due time, while a fractured bone has removed the other permanently.

Frank M. James

James has been with the team during the past three years and thus far has been credited with two major letters in that sport. Although Frank did not engage in athletics prior to his entrance at Armour, his interest in track during his freshman year carried him through his first preliminary training here.

Born in a small town located a few miles from Louisville, he attended grammar school there and later entered the Neale High School at Louisville, Kentucky. During the Fall of 1927, he entered Armour, enrolling in the department of Fire Protection Engineering.

His list of activities during the past years showed him as a rush leader in the sophomore year, a member of the sophomore, junior, and senior social committees, a junior marshal, secretary of the A. T. A. A., and a member of the Glee Club. He is a member of the Theta Xi fraternity, the Honor A society, and Tau Beta Pi and Salamander honorary societies.

A. I. E. E.

An opportunity to come in closer contact with some of the phases of power plant operation was afforded the members of the A. I. E. E., when R. B. Kellogg of the Northern Illinois Public Service Company addressed their meeting Thursday evening, January 15th, at the Engineers' Building.

In presenting his subject, "Power Plant Operation," Mr. Kellogg first stressed the importance of personnel organization. Then turning to the mechanical phases of his talk, he outlined various factors indispensable to the efficient operation of boilers, turbines, and other equipment.

His points were well backed up with numerous curves, carefully compiled data, and the necessary statistics.

A. I. Ch. E.

E. C. Lathrop, Research Director of the Celotex Company, addressed the Armour Branch of the A. I. Ch. E. Tuesday, January 13th, in the Physics Lecture Room. He presented a talk that illustrated many of the problems that confront a chemical engineer in the field today. In order to better illustrate his points he showed a reel of motion pictures.

The movie showed the various steps in the manufacture of Celotex. Dr. Lathrop passed out samples of the material that carried a printed slip telling of its insulating properties. The data for these sheets was compiled by Professor Peebles of the Institute. Professor Peebles has made many determinations of the heat resisting properties of the various types of Celotex.

W. S. E.

A business meeting of the Armour branch of the Western Society of Engineers was held Friday, February 20th. The chief purpose of the meeting was to discuss plans for the W. S. E. Smoker, which in the near future the members intend to have at one of the fraternity houses. A committee composed of P. Jordan, R. Windhigler, and B. McLaughlin was chosen to develop the plans of this social event.

It was also revealed at the meeting that as soon as the weather permits, an inspection trip will be made to the water crib, situated some two miles out in the lake, just opposite the foot of 68th street.

A. S. M. E.

The Beta Psi house was the scene of the A. S. M. E. smoker Friday, February 20th It was attended by forty of its members, all of whom enjoyed a happy evening. Bridge and other games furnished the entertainment. There were offered a door prize and a bridge prize. The smoker was climaxed by appetizing refreshments.

Professors Perry and Roesch of the mechanical engineering department were present and gave short talks concerning the organization. One of the new novelties being inaugurated was the award of a prize for the best attendance in A. I. T. classes.

Our Varsity Captains

Outdoor Track

Harold L. Fox, '31

Harold L. Fox, '31, co-captain with F. M. James, will endeavor to lead the outdoor squad into another successful year. Fox hailed from Newcastle, Indiana, where he attended the Newcastle grammar and high schools. During his last three years in high school, considerable time was devoted to track, a sport in which he exhibited his ability with great success.

Upon entering Armour in 1927, he again continued his track activities in his freshman year. Since then, he has been credited with one minor and two major letters, and also became noted as an outstanding member of the sophomore, junior, and senior interclass track championship teams. His accumulation of points for the team last year placed him next to Captain James of the indoor team. He has acquired great success in the 440 and 220 yard dashes.

Harold L. Fox

Fox, who is enrolled in the department of mechanical engineering, is a member of the Sigma Kappa Delta fraternity, and the Pi Tau Sigma and Honor A societies.

Harold is promising a good season for the team, one that will probably better last year's record. Much attention has been directed toward the training of the team thus far, and without a doubt the men on the squad are of high caliber and will show good results.

Basketball Team Shows Good Record

The Chicago Tech game marked the close of the basketball season. It resulted in another victory for Armour, thereby boosting the total of wins to eight out of thirteen. This record is about the best the squad has made for the past four or five years. Without a doubt these results were surprising, because much hope was lost when two regulars were forced to drop due to injury and sickness. This unexpected loss occurred in the earlier part of the season when the squad was all set for a good year. It forced Coach Krafft to start different lineups and develop new material for the various positions upon short notice.

Out of the five defeats suffered, we find that Western State Normal carried away two of the games. Two close matches were lost to Augustana and "Y" College in the first meetings, but when the second round was finished, the Techman split the bills by rather decisive scores. The Chicago Normal game proved to be one of the biggest upsets of the season. With our varsity leading by a big margin throughout the game, a series of uncanny shots pulled the Normal men ahead by a small margin during the last minutes of the game. As there was but one game scheduled with this team, a point of satisfaction could not be reached.

Looking down the list of individual scores, Harvey Rossing ranks first with a total of 116 points. Captain Robin holds second place with 79, Ott third with 58, while Beemsterboer follows with 52. These men constituted the heavy scoring end of the team, while Rutkowski, Omiecinski, and Yuknis controlled the defensive section with good work after Miran and Gustafson were forced to leave. Setterburg, Moskowitz, Lind, and O'Connor also offered helping hands in play when substitutions were necessary. Much credit goes to these men for their hard work during the past four months.

The scores of the games played this past season were:

Armour 42; Alumni 18
Armour 33; Chicago Tech 13
Armour 36; Wheaton 33
Armour 30; Western State 38
Armour 29; Chicago Normal 33
Armour 24; "Y" College 38
Armour 30; Augustana 34
Armour 35; Wheaton 23
Armour 28; Western State 60
Armour 27; St. Mary's 22
Armour 36; Augustana 28
Armour 37; "Y" College 24
Armour 33; Chicago Tech 27

Swimming Team Promises Successful Season

Armour Tech, this year, is represented by one of the best swimming teams in several seasons and it is a squad of which much is expected.

The team this year is composed of Captain Knox, Giovan, Byanskas, Cavanagh, Carlstrom, Weston, Davisson, and Thompson. Among the Freshmen who are aspiring to fill the places of these men in future years are Brockman, Kolve, Swanson, and Koenig.

Meets have already been held with the Hyde Park Y. M. C. A., Crane, and Culver. The meet with Hyde Park ended in a tie after a thrilling final event. Armour was defeated by Crane in a meet settled in the last few events by a score of 40 to 35. Then Armour was again defeated by Culver, 35 to 23, a school which has one of the best swimming teams in the country. Return meets are to be scheduled with these teams along with a few others before the season is completed.

The Armour relay team is made up of Knoz, Byanskas, Carlstrom, and Giovan. This combination, as a result of the sprinting of the anchor man, Knox, in a recent meet set up a new Armour record for the 160 yard relay. Three seconds were clipped off of the old mark, which was one of long standing.

In the breast stroke events, Cavanagh demonstrates how it should be done and under his guiding efforts Kolve has also been improving a great deal in the perfecting of his skill and speed. Thompson has taken very good care of the fancy diving, winning this event by wide margins in several instances. Kolve also has been training in the diving department, and is fast becoming very adept in this event. Another Freshman, Brockman, has shown great possibilities also in this phase of the meets, although being handicapped greatly by lack of sufficient experience. In the distance events we find Davisson and Weston, who have given very creditable accounts of themselves. Only recently another Armour record was broken by Weston in the 220 yard race.

SWIMMING TEAM 1930-31
Reading from left to right: Captain Knox, Davidson, Weston Carlstrom, Davisson, Kolve, Cavanagh, Koenig, Brockman, Thompson, Pfeiler, and Swanson.

Track Engagements Show Merit of Athletes

Disabilities suffered by important members of the varsity track team and lack of good material have not contributed to the possibilities of a successful season as the results of several engagements prove. However, there have been numerous flashes of excellent performance and the team deserves credit for its conscientiousness and determination.

Armour scored 28 points to Loyola's 94 in an informal meet at Bartlett Gymnasium, Feb. 6. Sears "Y" placed third with 24 points, University of Chicago "B" team placed fourth with 15 points, and Elmhurst trailed with 8. Features of the meet for the Armour team were: Capt. H. L. Fox's victory in the 440 yard run, A. H. Jens' second against a field of 22 men in the 50 yard dash, C. J. Jens' second in the shot put, Luckett's second in the pole vault, and Capt. F. M. James' third in the one mile run.

The interclass meet on Feb. 7 concluded with an easy victory for the seniors, who have won three consecutive championships. The seniors gathered 28 points, sophomores 15, juniors 14, and one freshman 9. For the seniors: A. H. Jens won the 50 and 220 yard dashes, Capt. F. M. James won the one mile and two mile runs, and Capt. H. L. Fox took first and second in the 440 yard run and 220 yard dash, respectively. G. Nelson, the single freshman, won the 880 yard run, 50 yard low hurdles, and the high jump.

In the triangular meet of Feb. 27, at North Central College at Naperville, North Central lead with 47 1-2 points, Loyola came a close second with 45 1-3, and Armour trailed with 14 1-3. G. Nelson of Armour won the 60 yard low hurdles and took second place in the high jump.

Nor did Armour fare well in the dual meet with Loyola at Bartlett Gymnasium Feb. 20, for Loyola won, 55 to 22, with seven first places. C. J. Jens of Armour won the shot put, Capt. H. L. Fox and K. S. Hirsch took second and third, respectively, in the 440 yard run. The Armour relay team, composed of A. H. Jens, Helmick, Kirsch, and Fox, won.

The Illinois Relays at Champaign, the Bankers Meet in Chicago, the third Armour Indoor Invitational Meet at Bartlett Gymnasium, and the 32nd Annual Central A. A. U. Championships conclude the indoor schedule for the present season. The tentative outdoor schedule includes Loyola, Crane College, Drake Relays, Invitational Meet at Stagg Field, and the Wisconsin State Teachers College.

Tau Beta Pi

Tau Beta Pi, honorary general engineering fraternity, elected C. T. Link, M. E., '31, president at a meeting held in their rooms Wednesday, January 22nd.

Other officers elected were:
R. M. Krause, '31, Vice-President
S. M. Lind, '32, Corresponding Secretary
I. B. Lehman, '31, Recording Secretary
J. O. Cavanagh, '32, Cataloger

Professor J. C. Peebles was re-elected to the office of treasurer of the chapter.

Other business transacted at the chapter meeting was a short report on the national convention by F. B. Attwood, '31, and the passing of an amendment to the constitution allowing officers to hold their positions for a year rather than only a semester.

Chi Epsilon

Chi Epsilon, honorary civil engineering fraternity, held a meeting in Chapin Hall, Tuesday, January 13th. The following men were elected to office:
R. H. Meagher, President
A. B. Auerbach, Vice-President
C. H. Miller, Secretary
L. H. Dicke, Treasurer

The above officers will hold their positions for the rest of the school year. Meagher and Miller are juniors, while Auerbach and Dicke are seniors.

Salamander

Salamander, honorary fire protection engineering fraternity, held a meeting at its rooms on Friday afternoon, February 27th, at which two members of the Junior class in F. P. E. were pledged. The men receiving the button were:
E. A. Scanlan, '32
G. W. Schodde, 32

These men were chosen because of their high standing in scholarship and their participation in school activities.

Sphinx

Sphinx, honorary literary fraternity, sponsored a smoker for the Press Club, held at the Sigma Kappa Delta House on Thursday evening, February 26th, at which seventy-five were present. Harvey T. Woodruff, Tribune sports writer, was the speaker and honor guest. Mr. Woodruff told many interesting incidents of his career as a writer, and gave the crowd a little inside information about the newspaper game. Sphinx will announce its new pledges within the next month.

Rev. Shannon Addresses Lincoln Assembly

An assembly in honor of Lincoln was held at the Institute on February 11th.

After a selection by the orchestra, President Raymond introduced the speaker of the day, Reverend Frederick F. Shannon, who spoke on "The Lincoln of the Waters."

A year ago, Reverend Shannon also had an occasion to speak about Lincoln, on the S. S. Homeric in the Mediterranean Sea. This time he also spoke on "The Lincoln of the Waters." He has always thought of the word "water" as implying a cleanliness of the man. Lincoln experienced a poverty which was a clean poverty. He stated:

"Out of poverty have come some of the noblest men of the world. Handicaps of wealth are greater than the average human being can overcome; and when one has had to eat out of a golden spoon, and does something great, it is a real achievement because wealth has its hindrances.

"There is something of the Sangamon River which reminds one of Lincoln; the Sangamon of simplicity. There is a certain simplicity along with the complexity of Lincoln's character. Seward and Stanton thought that Lincoln was simple and rustic, but they soon found out otherwise. There was a strain of beauty in Lincoln, which offset any angularity or awkwardness the man may have had."

The assembly closed with tremendous applause and the singing of the "Armour Fight Song."

Baseball Team Starts Indoor Practice

Coach Krafft has posted a notice announcing indoor practice rather early this season. After having very successful teams for the past four or five years, much attention has been directed toward the training of the new squad. It seems as though Coach Krafft is depending largely upon new candidates, namely the freshmen who captured the inter-class honors last fall, to lend a helpful hand. Veterans are scarce and of the old crowd we have only Captain Robin, Stehno, Link, Mago, and Pipe. Miran was forced out because of an injury that occurred during the basketball season, though there is a possibility that he may return in time.

F. P. E. S.

A meeting of the Fire Protection Engineering Society was held Friday, January 23rd. Mr. Howe, inspector in the fire protection department of the Chicago, Milwaukee and St. Paul Railroad, was the speaker. The fire protection department in connection with a railroad is a comparatively new idea, it being only one year old. However, the results shown by a year's labor justify the continuance and expansion of this branch of the railroad.

On February 13th, "Smoky" Rogers spoke before the society. In his talk, he told of the classes which firemen now attend, at which they are taught the fundamentals of engineering practice and also the ways of safeguarding life and property. He illustrated his speech with two reels of motion pictures.

Scarab

Scarab, honorary architectural fraternity, takes honor in announcing the initiation of:
Donald Braun, '32
Emil Minx, '31
Raymond Peterson, '32
Charles Schock, '31

The ceremony was held at the Delta Tau Delta House on Friday evening, February 27th. Many alumni attended the banquet which was a feature of the occasion. Professor R. H. Hammett and Instructors L. W. Suter and J. E. Peterson were present.

Pi Tau Sigma

At a meeting held January 22nd, in the Tau Beta Pi rooms, the following men were elected to office for the following semester:
R. M. Krause, President
F. F. Strassenberg, Vice-President
H. R. Davis, Recording Secretary
A. N. Cannon, Corresponding Secretary
R. H. Stevenson, Treasurer
H. L. Fox, Calatoger

Phi Lambda Upsilon

Phi Lambda Upsilon, honorary chemical engineering fraternity, held a short meeting at the chapter's rooms Wednesday, February 21st.

All of the members were present except Drell and Yzaguirre.

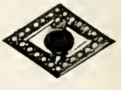
Pi Nu Epsilon

Pi Nu Epsilon, honorary musical fraternity, held an initiation Wednesday, December 17th. After the ceremony, which took place early in the evening, the members attended a musical comedy at one of the loop theaters.

The following men are the new members:
F. F. Strassenburg, M.E., '31
Phil H. Korrell, E.E., '32
G. L. Bonvallet, E.E., '32

Eta Kappa Nu

Eta Kappa Nu, honorary electrical engineering fraternity, announced its annual essay contest early in March. The results will be posted after the Easter holidays and the author of the winning paper will be presented with a copy of the Standard Handbook for Electrical Engineers.



To the fraternity rooms a certain degree of color has been added by the acquisition of a new rug. A radio set, built by the ex-pledges, was also installed.

A theater party is being planned for the near future.

The Armour Alumnus

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C. W. Farrier Studies Mayan Ruins for World's Fair

Spends Three Weeks in Yucatan With Rufus Dawes, President of Exposition

Clarence W. Farrier, Arch., '16, who is the Assistant Director of Works for the Century of Progress, recently returned from Yucatan, where for three weeks he had been studying the Mayan ruins. Accompanying Mr. Farrier were Rufus Dawes, President of the World's Fair of 1933, and Doctor Clarke of Northwestern University. The purpose of the visit was to investigate the ruins of the Mayan civilization, so that some particular project of that day might be exactly reproduced here in Chicago. It was decided that the Temple of the Gods should be built for the Fair, the design and construction of which is to be under the direct supervision of Mr. Farrier. It is to be made of concrete and is to be built this year.

The first active research into the Mayan ruins was begun in 1886 under the direction of the Mexican Government and the Carnegie Foundation. It was found that most of the buildings had been built in the era of Christ, while authentic data was uncovered showing that the civilization itself existed even before that of the Babylonians. Their architecture was distinct and original, giving evidence that no other people or race influenced it.

C. W. Farrier

An exact reproduction of one of the Mayan buildings should be of interest to visitors at the Century of Progress Exposition, for the reason that the original beauty of it dates back thousands of years to the self-contained Mayan civilization.

Henderson, '02, Heads Large Company

Roy Manwaring Henderson, E. E., '02, one of the trustees of the Institute, has recently been promoted to the position of President of the United Engineers and Constructors, Montreal, Canada. The position formerly held by the executive was that of Managing Director of the same company.

Henderson was a characteristic Armour student in his undergraduate days, since it was necessary that he work during his spare hours to help him through college. Roy had a peculiar fondness for electricity and procured the job in the Institute of looking after electrical equipment and wiring.

Henderson on leaving Armour worked for a railroad down in Mexico. He then came back to the Institute for advanced study and received his master's degree in 1906. B. J. Arnold and Company claimed his services for a time and later he affiliated himself with the Chicago branch of Stone and Webster, a company of engineers, constructors, and operators. He rapidly rose to the position of Chicago manager. Still later he severed his connections with Stone and Webster and joined the forces of Dwight P. Robinson, General Engineers. In due time the title of Vice-president was bestowed upon him. While Mr. Henderson was in the employment of the Dwight Robinson organization they combined with several other engineering firms and it is of this group,—The United Engineers and Constructors,—which Mr. Henderson now heads.

Dr. Pease Assists on the Retest of Speed and Light

Last month Dr. Albert A. Michelson, Nobel Prize winner in Physics and honored speaker at Armour a few years ago, conducted his final experiment on the speed of light because he wasn't satisfied with the results of his tests of several years previous. The speed of light as calculated from data of the earlier experiment was 186,285 miles per second, and this, according to Dr. Michelson, was less than one mile per second in error.

Dr. Michelson was supervising the retest of the speed of light with improved equipment until February 22nd, at which date he retired, due to illness. Dr. Francis G. Pease, E. E., '01, astronomer at the Mt. Wilson observatory, and Mr. Fred Pearson, Dr. Michelson's personal assistant, continued the experiment which will be completed shortly. Many and lengthy calculations are inevitable before any new data on the speed of light can be announced. The greatest care in the installation of apparatus, use of precision instruments, selection of operating staff, and care in maintaining correct natural conditions while experiments are conducted, tend toward an accuracy in the speed of light which shall be the standard for an infinite time.

Victor Proetz Will Lecture To Architects

Victor Proetz, Arch, x-'23, crossed the Atlantic last summer to study European architecture. Mr. Proetz is an authority on Swedish architecture and spent much of his time on the Northern Peninsula. Professor Reed indicated that Proetz is scheduled to lecture to the Armour Institute and the Yale University departments of architecture on his specialty,—Swedish architecture. Mr. Proetz is to talk before the Armour group early this spring.

Graduate Assists In Theatre Design

The unique interiors of the Punch and Judy theatre, one of Chicago's newest cinemas, was designed with the assistance of Eugene Fuhrer, Arch, '23, who acted as associate architect on the project. Fuhrer is employed by the Roberts and Schaeffer Company, 1110 Wrigley building, Chicago.

National Committee Invites Armour Architect

Pierre Blouke, Arch., X-'16, has been accorded national recognition for his ability in architectural design, having recently been invited by Secretary of Commerce R. P. Lamont to become a member of an important committee on house designing. The conference has been sanctioned by President Hoover and is called the President's Conference on Home Building and Home Ownership.

Mr. Lamont, in a letter to Pierre Blouke, said, "That the committee on design can make a definite contribution toward improved planning of house construction throughout the country."

Louis W. Chatroop, Jr., C. E., '26, is employed in the service of the Universal Oil Products Company, Chicago, Illinois. Chatroop is engaged in the designing division of this company.

PERSONALS

George A. Kloepfer, '29, recently visited the Institute. He is an ensign stationed at the Atlantic Fleet Air Base, Hampton Roads, Virginia.

At least three alumni are preparing to jump into the holy seas of matrimony. Announcement has been received of the engagement of Jerome Goldstein, '23, to Miss Mary Rose Greenstone; Harold E. Ross, '27, to Miss Beatrice Marie Peters; and Oscar M. Pinsof, '29, to Miss Ruth Lillian Goldman.

Omar O'Grady, C. E., '17, mayor of Natal, Brazil, headed a committee of welcome to members of the National Geographic Society's aerial survey expedition recently.

John Tarman, '30, and Charles Morris, '30, are with the Research Department of Armour and Company.

J. J. Doheny, '27, is a high school instructor in Chicago. He is at present working on a chemical engineering problem at the Institute as a project for an advanced degree.

Harry Krieger, '28, is with the Ohio Inspection Bureau in Columbus.

Francis Montgomery, C. E., '24, recently appeared on the scene once more when he visited the Institute.

Reginald Schuler, E.E., '27, is employed by the American Teletype Corporation, 1400 Wrightwood avenue, Chicago, Illinois. Schuler has been working diligently on a new kind of stock quotation board.

Balthasar Hoffman, Ch.E., '07, dropped into the Institute a short time ago to chat with his old professors and to convey information to the Dean's office about a prospective Armourite. Hoffman resides in Valparaiso, Indiana.

Charles H. Hammond, Arch., '04, just recently resigned as President of the American Institute of Architects, a position he held with much distinction.

Robert C. Ostergan, Arch., '08, of Hall and Ostergan, architects, 155 N. Clark Street, Chicago, has several positions of importance in the realm of architecture. Ostergan is President of the Illinois Society of Architects and is a member of the state board of architectural examiners.

Earl R. Sanborn, F.P.E., '24, is employed as an insurance engineer with Christ Schroeder and Sons, Insurance Agents, located in Milwaukee. Earl recently motored down from Wisconsin to renew old acquaintances at a fraternity initiation.

Paul Durbin McCurry, Arch, '26, who spent a considerable length of time in Europe studying about the science of building, returned a short while ago. He reports that the time was well spent.

James Kara Killed in Auto Accident

James J. Kara, C. E., '30, captain of the track team in 1929, died February 8th as the result of a serious accident caused by the crashing of his car into an electric light pole in an isolated portion of the south side of Chicago. Friends of Kara were shocked when news of the death of this alumnus became known. "Nap," as he was affectionately called, was apparently on the road to recovery from the accident when death snuffed out his life. The contributory cause of Jim Kara's passing was probably brought about by acute exposure, as he lay in an unconscious state for almost an hour before aid came.

The fighting spirit of Kara aided materially in restoring his unconscious body to a point where recovery seemed assured. To the end he was optimistic, a trait which was always preeminent when he participated as a member of Armour teams. When Nap was a star, Tech track teams were never defeated until the last event was concluded. He would, if necessary, enter all the events possible when the team was behind because he was one of those rare individuals to whom defeat was distasteful.

James Kara

Kara had many idiosyncracies wound up in his highly amiable personality which made him a unique figure among his legion of friends. He was always ready to give a helping hand. For example, on the night of the fatal accident he was giving one of his co-workers a lift home from the shop where they had been working overtime to a late hour. Naturally, Kara speeded in order to make up for the loss in time caused by assisting his fellow worker home, and at a critical point he lost control of his car.

Many Armour students paid respects to James Kara's memory. Members of the Truss Club, to which Kara belonged, acted as pallbearers at the funeral.

G. Earl DeBourge, C. E., '28, is connected with the engineering staff of the Cook County Board of Assessors.

PERSONALS

Gustave G. Erland, M. E., '30, who has a brother in the present senior fire protection class, is an engineer in the employ of the Illinois Steel Company, South Chicago, Illinois.

Edward R. Rowley, M. E., '30, was married on January 24th to Miss Dorothy Spengler. They are now residing in Cincinnati, Ohio, where Jeff is employed by the Proctor and Gamble Soap Company.

Roscoe Williams, C. E., '13, is now vice-president of the Federal Electric Company at Louisville, Kentucky.

James G. Fee, M. E., '30, is now teaching mechanical drawing in one of the Chicago Junior High Schools.

Eberhard E. Wettley, M. E., '26, is now a patent attorney associated with the firm of Brown, Boeltcher, and Dienner, located in the Monadnock Bldg., Chicago. Morris Spector, E. E., '23, is also connected with the same firm.

Robert I. Wishnick, Ch. E., '14, is president of the Wishnick Tumpeer Chemical Company, 251 Front Street, New York City. Products of the company sell under the trade name of Witco and are widely used in the chemical industry.

George A. Amundsen, C. E., '28, is now employed as a foreman for the E. J. Albrecht Company, 35 S. Dearborn Street, Chicago.

Boyden Hindman, E. E., '29, is employed as a field engineer for the Public Service Company of Northern Illinois. Hindman was Editor-in-Chief of the Cycle in his last year at school. Boyden was a visitor at the Institute a few weeks ago.

The Wilson Avenue Y. M. C. A. seems to be a rendezvous for Armour alumni and students seeking athletic endeavor. Some of the more persistent adherents of physical culture among the older Armourites are Victor Hoefer, Charles Schonne, Joe Grosguth, Abe Benjamin, and the Schuler brothers, Ted and Reg.

John W. Hurley, C. E., '30, is ranked as a student aviator in the United States Naval Reserves. John, at the present time, is stationed at Pensacola, Florida.

Marion F. Bacon, E. E., '19, until recently held a position with the Electrical Sales Company of Fort Wayne, Indiana. Bacon is now credit manager of the Protective Electric Supply Company, situated in the same city.

The oil fields of Oklahoma have called Dwight O. Barrett, M. E., '08, who formerly held a very good position with the Superior Gas Engine Company of Springfield, Ohio. Barrett is now employed as designing engineer for the Sypsy Oil Company of Tulsa, Oklahoma.

Alumnus Wins Chicago Sketch Club Prize

Alexander H. Bacci, Arch., '26, is now studying architecture in Europe on a scholarship presented to him by the Chicago Sketch Club for his excellent rendering of a "Concrete Bridge Over the Chicago River," which was the problem specified in the competition. Bacci, working in connection with A. Erwin Nicolai, Arch., '25, pocketed the House Exhibits prize awarded for a home designed in Evanston. Incidentally, Bacci's brother is now attending the Institute.

Fire Protects With Missouri Bureau Turn Publishers

The March issue of the "Firerater," the official organ of the Missouri Inspection Bureau, is a very unique publication this month, since it embodies all particulars relative to Armour Institute, its alumni, and students employed in the bureau for summer field work. Every article and personal sketch in the latest issue is the work of some alumnus or student and should be indeed interesting to all Fire Protects.

Dobberman Wins a Traveling Scholarship

Marvin Dobberman, Arch., '30, was the recipient of the American travelling scholarship which was awarded by the Lake Forest Foundation. The scholarship is for a period of one year and at the present time Dobberman is traveling in the South. The coveted prize was awarded for distinctive work.

Temple Sholom Is the Work Of Alumni Architects

The company of Loebl, Schlossman, and Demuth, 612 N. Michigan Avenue, Chicago had charge of the designing of the beautiful Temple Sholom along the North Shore of Chicagoland. They also had charge of building the new Thompson Restaurants which have sprung up in recent months. Norman J. Schlossman and Irving J. Loebl were classmates in the department of architecture and were graduated in 1921. The other partner, John J. Demuth, received his degree a year later.

Willard A. Anderson, C. E. '28, according to a recent announcement has acquired a help mate. The fortunate young lady is Kathryn Margaretta Zost. The wedding ceremony was in the bride's home town, Chambersburg, Pennsylvania, January 31, 1931.

News of the promotion of Earle S. Whitcombe, F. P. E., '25, has reached Armour. Whitcombe will now pursue the duties of a special agent for the Hartford Fire Insurance Company. Earle's headquarters are in St. Louis, Missouri. Previous to his new appointment, Whitcombe held a position with the Illinois Inspection Bureau.

Dean Monin Recuperating From Serious Illness

Over in Zurich, Switzerland, that great counselor and philosopher, Dean Monin, is convalescing from a very serious illness, after a protracted period in a hospital. President Raymond reports that Dean Monin would greatly appreciate letters from his former students. The answering of letters by him is practically impossible since the beloved former dean is confined to his bed and is thoroughly incapacitated. It is hoped that many alumni will heed this message and communicate with Dr. Monin. His residence in Zurich, Switzerland, is 71 Gladbach Strasse.

Dean Monin

Jennings 26th In National Tennis Ratings

It is interesting to note that George Jennings, Jr., E.E., x-'29, received national rating for his tennis achievements of the past year. The American Lawn Tennis Association awarded Armour's greatest racket wielder twenty-sixth position. Many Armourites have wondered why George has never received higher national recognition by the official body. It is understood that he did not participate in enough tournaments sponsored by the official body to demand serious consideration.

Leroy F. Bernhard, E. E., '29, and Editor of the Armour Engineer during his senior year, is following the profession in which he majored at college. Bernhard is now an engineer for the Illinois Bell Telephone Company, 212 W. Washington Street, Chicago.

Carmen J. Clement, Ch. E., '26, is chief chemist for the Chicago plant of the Proctor and Gamble Company located at 1232 W. North Avenue.

In the competition sponsored by the Standard Plumbing Fixture Company, Eugene Voita, Arch, '25, won a prize of $200.00 for his work in designing a specified project.

Prof. Paul's Disciples Please Take Note

Not so long ago a large flat package arrived in the supply store, addressed to Professor Charles Edward Paul, Head of the Department of Mechanics. Later, in the offices of the Department of Mechanics in Chapin Hall, Professor Paul was found diligently wrestling with the parcel. Immediately complexities developed for a large photograph of an engineering project was the fruit of the unfolding process. A note accompanied the picture, however, and its contents were something like this:

"Dear Professor:

I think this is the kind of a water shed you had reference to when you called on me for the definition of it in Junior Hydromechanics.

Signed, William Berry, '29."

The illustration which was sent indicates that it could hardly be a shed to contain water.

How many of us who have been favored by studying under the guidance of Professor Paul could recall similar bonehead recitations while being cross-examined in Strength and Hydromechanics?

Berry is a fire insurance inspector with the Missouri Inspection Bureau. Bill was a scholarship "fire protect" during his college days.

Professor Paul states that the memories of instances of this kind are a few of the bright spots of academic days, both for the graduates and the faculty.

Alschulers Vacationing Abroad

Alfred S. Alschuler, Arch., '99, trustee of Armour Institute, is now voyaging in Mediterranean waters with his family. The Alschulers intend to stop off at the most interesting portions of Europe, Asia, and Africa during their three months sojourn.

Frank Oster Recuperates From Illness

Mr. Frank Oster, custodian of Armour since the Institute's very beginning, was the victim of a sudden illness caused by a nasal hemorrhage. He is back at his position again, however, after being missed by both the students and the faculty. Frank still has a yen for making scrap-books, several of which are now in the process of making.

Charles H. Jones, F. P. E., '30, is looked upon by many who are asthetically inclined, with no little envy. Charley is employed as an inspector for the Rocky Mountain Inspection Bureau. Every once in a while a missive comes into our hands from some small town in the heart of the Nevadas with information about beautiful Colorado, and also a few words that inspecting is quite intriguing, too.

STEPPING INTO A MODERN WORLD

Out of 25 telephone companies

...ONE SYSTEM

Greater ability to serve the public is the reason for the Bell System — made up of the American Telephone and Telegraph Company and its 24 associated telephone companies.

The Bell System is operated by these 24 associated companies, each attuned to the area it serves. Each enjoys the services of the staff of the American Company, which is continually developing better methods. Each benefits from the work of the Bell Telephone Laboratories and Western Electric — scientific research and manufacturing branches of the System.

Bound together by common policies and ideals of service the Bell System companies work as one. In helping to administer this $4,000,000,000 property, men find real business adventure. *The opportunity is there!*

Centralized manufacture at

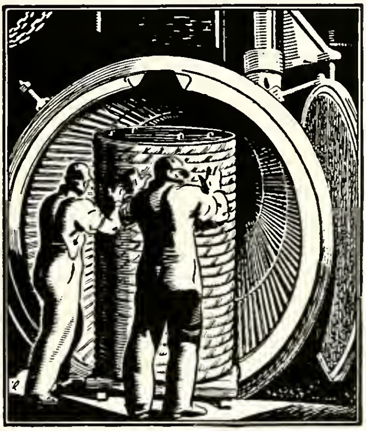
WESTERN ELECTRIC

has become an applied science . . .

Carrying out this Bell System idea of coordination, virtually all Bell telephone apparatus is made by one company — Western Electric. In practice it has been proved that this undivided responsibility makes possible greatest efficiency and economy.

Purchasing of raw materials in every corner of the globe is coordinated with future manufacturing programs. At three great plants production is geared to changing telephone needs. A nation-wide system of distribution is always ready to meet emergencies as well as normal requirements.

Through 50 years of manufacturing for the Bell System, Western Electric men have built up a code of practice that is truly scientific in its thoroughness.



Into the oven goes a truck of telephone cable. Under vacuum, dry heat of 230° removes any moisture that might otherwise interfere with telephone calls.

BELL SYSTEM

A NATION-WIDE SYSTEM OF INTER-CONNECTING TELEPHONES

YOU'RE RIGHT

Question: "What is to be more desired in an accident than presence of mind?"
Answer: "Absence of body."

The best jokes are not printed here. They walk around on two legs.

Onions are the secret of good health, but who can keep the secret?

Ted: "You'll never go to heaven if you talk that way."
Mac: "I won't go anyway; I own the other place."
Ted: "How's that?"
Mac: "Father gave it to me last night."

Professor: "You are a candidate for flunking."
Stalzar: "I hope I am defeated."

Pete: "There is something dove-like about you."
Repeat: "What is it?"
Pete: "You're pigeon-toed."

Assembly Speaker: "How long have I spoken; my watch has stopped."
Back Row: "There's a calendar on the wall, sir."

He: "See the dancing snow flakes?"
She: "Practicing for the snowball, I suppose."

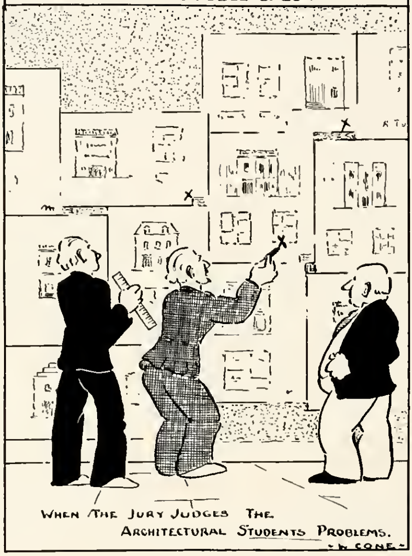
He: "Women are more forgiving than men."
She: "I'll admit they make up oftener."

HEAVY STUFF

"How did you hurt your eye?"
"Oh, a lid fell on it."

He: "May I hold your hand?'
She: "Of course not. This isn't Palm Sunday."
He: "Well, it isn't Independence Day, either."

CHECK & DOUBLE CHECK



WHEN THE JURY JUDGES THE ARCHITECTURAL STUDENTS PROBLEMS.

NOT SO MUCH

Cat: "I am proud to say I have nine lives."
Frog: "That's nothing. I croak every day."

He who laughs last probably had it explained to him.

Scherger: "Did you hear that the bones of Columbus have been found?"
Schommer: "You don't say. I never knew he was a gambling man."

One: "What does your roommate like?"
Two: "Pretty nearly everything I've got."

Teeny: "Can anything come between us, dear?"
Weeny: "Not unless you move over."

"Can you dance?"
"Yes, I love to."
"Great! that beats dancing any day."

He: "Yes, she was hanged in China."
Her: "Shanghai?"
He: "No, not very."

Tom: "I tell you this play makes me think."
Sue: "Miracle play, eh?"

"Does your uncle have much liberty in prison?"
"I don't know, but I understand that they are going to give him a lot of rope in the near future."

JUST TWO PALS

Black: "I'll meet you on the corner at 2:30, and if I get there first, I'll make a cross on the sidewalk."
White: "Fine, and if I get there first, I'll erase the cross."

"Waiter, there's a fly in my ice cream."
"Let the little rascal freeze to death. He was in the soup yesterday."

Soph: "What's a good example of coincidence?"
Frosh: "My mother and father were both married on the same day."

Artist: "Is the editor particular?"
Staff: "I'll say he is; he raves if he sees a period upside down."

Freud: "This is the third time you have looked on Dave's paper."
Murphy: "Yes sir. He doesn't write very plainly."

CRAM, MY BOY, CRAM

Sake: "When do the leaves begin to turn?"
Bryant: "Night before exams."

He: "You are the sunshine of my life. Your smile dispels all clouds. With you at my side, I could defy all storms."
She: "Is this a proposal or a weather report?"

Rudy: "What do you think of the News."
Vern: "Oh, the paper's all right."

"No, my father wasn't exactly a policeman, but he went with them a great deal."

Tom: "How do you suppose a man with two wooden legs manages to walk?"
Fred: "He probably just manages to lumber along."

TWO HEARTS

Dollar: "Do you think this suit is all right for a bridge date?"
Bill: "What bridge is the date on?"

"What were the ambitions of your boyhood days?"
"I wanted to be a millionaire, but I found out it cost too much."

Bob: "What's an usher?"
Bus: "A guy that takes the leading part in the theatre."

Harry: "I must be off."
Ben: "That's what I thought when I first met you."

"It's all over now," said she, as she finished powdering her nose.

Ready: "What is the surest way to keep milk from souring?"
Go: "Leave it in the cow."

Development of the Chicago Type Bascule Bridge

(*Continued from page 83*)

per deck which carries motor vehicles entirely. Later, on the new La Salle Street bridge, a flooring of asphalt planks laid diagonally was used. A new development consisted of using pre-cast light concrete slabs which are fastened to the supporting stringers by lugs imbedded in the slab and welded to the steel beam. This type is used on the recently opened Wabash Avenue bridge.

There has also been a steady improvement in the mechanism to operate the bridge. Earlier designs consisted of complicated gear trains with bearings mounted on built up steel girders which in time, due to their lack of rigidity, showed the need for a more solid alignment of shafts and gears. It was at first thought necessary to tie together with shafting the two or three gear trains operating the rack pinions, in order that one might not run ahead of the other. However, now with the more rigid superstructure, each gear train, with an individual electric motor of from 80 to 100 H.P., operates on a rack, usually of the internal type, in the heel of the truss. In spite of the development in recent years of compact planetary speed reducers, experience in bridge operation has shown that the simple three or four shaft spur gear train is best. The loads imposed are so great and freedom from breakdown so essential that great ruggedness of design is necessary. Heavy cast steel bearing frames carrying alloy steel shafts and cut tooth steel gears throughout are now standard practice. The rack gear teeth now needed to carry the loads imposed are over five inches thick with an eighteen inch face and are of special section. Gear wheels run to six foot and seven foot diameters and are carried by twelve to eighteen inch shafts. A service hand brake is provided in addition to an automatic motor shaft brake. The trunnions that carry the leaf are keyed to the trusses and revolve in bearings mounted on each side of each truss. The outer bearing is carried on a pedestal, while the inner is carried on a curved longitudinal girder running from the river pier to the anchor pier in the rear. Present day bridges require trunnions varying from two to three feet in diameter and nine feet long.

Around this machinery must be built the enclosures and a building to house the control apparatus. Formerly these were but wooden shelters and at the best were unsightly. Today beautiful limestone towers flank the approaches and harmonize with the surrounding architecture. The columns supporting the houses rest directly on the substructure and from these is framed the steelwork carrying the sidewalks and house floors. Usually a bridge house is made with from three to five floors. The lowest floor is the dock level on top of the bridge pit. On this floor the heating equipment for the enclosures and house is placed. Midway between the dock level and the side walk level is located the lower mezzanine floor which houses all the electric control apparatus. The house entrance is at the sidewalk level floor and here is located the locker and general utility space. Above this may be one or two floors depending on the requirements of visibility for the operator for a deck or pony truss type bridge. The top floor is the operator's room, commanding a view of both river and street traffic in all directions from the windows on all sides.

Tawny

These are the tawny days; your face comes back.
The grapes take on purple; the sunsets redden early on the trellis.
The bashful mornings hurl gray mist on the stripes of sunrise.
Creep, silver on fields, the frost is welcome.
Run on, yellow balls on the hills, and you tawny pumpkin flowers, chasing your lines of orange.
Tawny days, and your face again.

—*Carl Sandburg*

To give in any detail the procedure of the design of the modern Chicago Type Bascule would be a long and involved discussion. Suffice is it to say that today the magnitude of the work requires many individuals, each highly specialized in the design of some particular phase of the work. Only a brief description of the determination of the loads involved can be given here. In the first place, a bascule differs radically from a fixed bridge in that it receives loads in two planes, vertical and horizontal. The vertical loads are the usual ones of dead load, live load, and impact or vibration. The live load through various systems of wheel applications approximates 200 pounds per squae foot. Horizontal load is due to wind pressure against the leaf and must be resisted through the rack and pinion of the gear train and its brakes. The bridge machinery is designed to hold the leaf against a pressure of 20 pounds per square foot of projected area, and to operate against a wind maximum pressure of 10 pounds per square foot. Against a 2 pound wind the leaf must be opened in approximately 45 seconds. The amount of the rack tooth pressure can be appreciated when it is realized that the area of the leaf exposed to wind is at least 65 to 70 feet wide and about 100 feet high, and has a moment arm of perhaps 60 feet to a rack radius of approximately 20 feet. These horizontal loads combined with the dead loads must be carried down through the supporting girders to substucture and piers. Trunnions must be designed to carry and revolve with this resultant load of over 1,500,000 pounds, and the trunnion bearings transmit this concentrated load to a longitudinal girder approximately 50 feet long. Besides this, calculations must be made for shear lock loads transmitted from leaf to leaf, also traction loads and various possible combinations of different loadings.

To say that the ultimate had been reached in bascule design would be short sighted. Each new design shows some new improvement, longer distances spanned, wider roadways provided, and modern structural beauty incorporated. Each bridge built stands as an engineering achievement whose useful life is now only measured by the requirements of a city's traffic 30 to 40 years hence. The only limiting factors of design are the materials available for economic construction. As alloy steels are cheapened and made in structural shapes it will be possible to increase the loadings or decrease the sections. It perhaps is not even hazarding too much to say that eventually the new art of welded fabrication can be adapted to bridge erection and the section-destroying rivet hole abandoned. It should be added that the thing that has made this present achievement in design of Chicago Type Bascule bridges possible has been not only a river requiring many crossings, but the power of a city always to fulfill its needs.

Electric Conduction In Metals

(*Continued from page 88*)

num falls to a minimum at about 12° absolute and then remains constant, or in other words the coefficient of resistance vanishes. This remarkable property of super conductivity presents a result exactly opposite to that predicted by the electron theory.

According to the picture of an electron gas in metals, we should expect the specific heat to arise from increases in energy of the electrons as well as the atoms; in other words, that the specific heats of metals should be higher, per atom, than the non-metals which contain few free electrons. As a matter of fact, the electrons contribute nothing to the specific heats, the massive ions accounting for the whole. This discrepancy is one of the more conspicuous failures of the electron gas theory.

Attempts have been made to explain these objections by application of the quantum theory of the atom. In this concept the electrons are not free in the sense that they behave as a perfect gas, but are revolving in definite orbits about the positive atomic nucleus. The quantum theory specifies that if the electron moves to a new orbit it must do so in a single jump and not continuously; and further, that only certain definite orbits are possible. A field applied to such a group of atoms drives an electron from its orbit in one atom to one in the next and so produces a drift current as explained above. This modification overcomes the objection that the electrons do not contribute to the specific heat, since they no longer act as a gas and the energy in the orbits is not influenced by temperature. It does not, however, explain the other difficulties, in particular, superconductivity. Many and varied attempts have been made to bring the facts of conduction into line with the quantum theory but without success.

The most adequate and complete theory of metallic conduction at present is based on the wave theory of matter. This wave theory and its subsequent developments requires for its complete statement considerable mathematical equipment; no models are quite satisfactory, so that only the results as they affect the conduction problem may be presented here.

There has long been a dual theory of light. Newton's corpuscular theory was retired for many years in favor of the wave theory, which pictured all radiant energy as transverse vibrations of electric and magnetic fields through the ether of space.

The discovery of photoelectricity and the Compton effect have brought about a revival of the corpuscular theory, differently stated. As an example of photoelectric emission, consider a point source of light which on the wave theory sends out a spherical wave in the form of expanding concentric spheres. The total energy radiated is constant, so that unit area on the wave front one meter from the source allows the passage of a certain amount of energy; and a square centimeter ten meters away, one one-hundredth of this energy. Now suppose a metal is placed one meter from the source; one or more electrons will be ejected from the metal, each possessing a definite energy which can be measured. This is the photoelectric effect. If the same metal is placed at ten meters, the ejected electron will have exactly the same energy as in the first position, although the intensity is only one one-hundredth part. On the wave theory this is unexplainable. A similar result is found for X-rays and is known as the Compton effect. When X-rays, which are much shorter in wavelength but of the same general character as light, strike an atom, they behave in many ways like a corpuscle having energy and momentum. The atom bombarded recoils and the X-ray is reflected and moves on with less energy than before the collision. Energy and momentum are conserved as in ordinary mechanical problems.

One Woman

Since I heard them speak of her great shame
I looked upon her face with curious eyes,
But pity in my heart became surprise,
Finding not any havoc there, nor flame;
Only a little smile that went and came
As if she knew a mirth too great and wise
And far too proud to serve the world with lies,
Disdaining as she did its praise or blame.

She who had passed through sin, as through a door,
Stayed not upon the steps to wail and beat
Against a portal closed for evermore;
But smiled, and went her way with tireless feet.
When night had passed and the long day begun;—
So Hagar faced the desert with her son.

—*Zoe Akins*

These two experiments have led to a corpuscular picture of radiation, in which the right ray is treated as a wave motion. For example, the simple experiment in which light is diffracted when passing through a grating is an application of the wave theory. It then becomes necessary to regard light as corpuscular when dealing with its interaction with atoms individually, but as a wave motion when reacting with large groups of atoms such as constitute a grating.

Although there have been two theories of light, there has only been one theory of the electron. In the past, the properties of electrons and protons all seemed to be those of corpuscles of electricity. In 1927 it was accidently discovered that a beam of electrons produced a diffraction pattern in much the same way as a beam of light or X-rays. Subsequent experiments have shown that both electrons and protons show properties of waves under many other conditions. On the basis of experiment, there is as much justification in treating a beam of electrons as a train of waves as a train of corpuscles and the symmetry of the wave. Thus the corpuscular theory is complete. The duality of nature of both light and electrons is now a firmly established experimental fact.

Statement of the wave properties of electrons in quantitative form has given a theory of metallic conduction which removes most of the difficulties encountered in the old electron theory. Surprisingly enough, the picture is still that of free elecetrons drifting down the conductor under the influence of the electromotive force. It was not the physical model of conduction that was wrong but the dynamics of the electrons. Also we are still justified in speaking of the electrons as particles, but in determining the way they behave we must use their wave properties.

From the wave properties of electrons it is possible to calculate how the velocities in the electron gas are distributed. The new distribution is shown in Fig. 4 and it may be compared to the distribution under the old electron theory shown in Fig. 1. For the new distribution, which is called that of a degenerate gas, it may be seen that the velocities change very little between 0° and 100° C. and we should thus expect very little change in the energy of the electrons with temperature. This confirms the experimental fact mentioned above that the electrons make no appreciable contribution to the specific heats.

Using this same distribution of velocities, the conductivity may be calculated and also the dependence of resistance on temperature. From the wave point of view, the electron waves are scattered by the ions of the metal crystal in much the same way that light is scattered when passing through the earth's atmosphere. Hence, the problem of determining resistance amounts to finding the way in which these electron waves are diffracted by the ions in the metal. It is also possible to calculate the dependence of resistance on the temperature, and it is sufficient to point out here that this result gives the first satisfactory explanation of superconductivity and the way in which the resistance depends on the temperature. The thing that produces the diffraction of the electron waves and consequently the resistance turns out to be due to irregularities in the arrangement of metal atoms. This may come about through the presence of impurities or through the heat motion of the ions. The latter effect produces the resistance in pure metals.

In addition, contact differences in potential, thermo-electromotive forces, Peltier effect, and many other problems of metals are very well accounted for under this theory.

The application of wave-mechanics to the theory of conduction is only one department of physical theory in which it has met with success. The problems of spectra, magnetsim, radioactivity, and others have been correlated in a more comprehensive way and many defects of the quantum theory have been eliminated.

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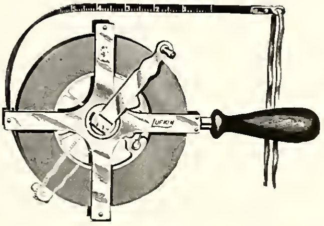

THE LUFKIN RULE CO.
SAGINAW, MICHIGAN

Aircraft Engines

(Continued from page 91)

compression engines. Fuels between 68 and 75 percent Octane equivalent are suitable for the Challenger 5.2 compression, Wasp 7/1 Blower Whirlwind 9 cylinder J-6, and Cyclone and Hornet engines. Fuels meeting the new specifications of 87 percent Octane equivalent are recommended for high-duty engines such as the Whirlwind 9 cylinder J-6, 6.0 compression, and the Conqueror 7.8 compression engines. The range of fuels discussed range in the following order from the poorest to the best in anti-knock value:

374° End Point Domestic Aviation (Mid-Continent).
California Columbia & Venezuela D. A. G.
Ethyl Motor Standard 1931.
40% Benzol in Mid-Continent D. A. G.
Esso (Equiv. 50% in MidContinent).
Stanavo + 3 ml. lead.

Aircraft Accidents

The N. A. C. A. Report No. 357 of January 28, 1930, analyses accidents for the avowed purpose of accident prevention study and classifies the accidents in a critical manner as follows:

(1) The Nature of the Accident; (Collisions, Spins, Forced Landings, Take-off Accidents, Fires, Structural failures, and Miscellaneous).
(2) Injury to Personal; (Deaths or Serious or minor injuries to Pilots or Passengers).
(3) Damage to Material; (Complete destruction, Major overhaul, Major assembly replacement, and Minor Damages).

The causes of accidents are classified as follows:

(1) Personnel; (Pilot's error of judgment, Poor technique, Disobedience, Carelessness or Negligence, Supervisory errors of navigators, Formation leaders, Ground operations officers, Ground crews, and aerographers.
(2) Material; (a) Power Plants; (Failures of Fuel, Cooling, Ignition or Lubrication Systems, Engine Structure Propeller, and Controls).
  (b) Structural Failures; (Flight control systems, Movable Surfaces, Stabilizing Surfaces, Wings, Struts, Braces, Landing Gears, Wheels, Tires, Brakes, Floats, Fuselage, Engine Mount, Tail Skid, and Arresting Devices).
  (c) Handling Qualities; (Controllability as involving ground loops, spins, etc.).
  (d) Instruments; (Failure of essential instruments).
  (e) Launching; (Catapults).
(3) Miscellaneous; (Weather, Darkness, and Terrain).

The nature and the causes of aircraft accidents occurring before January, 1929, have been classified according to Tables No. 2 and 3 in N. A. C. A. Report No. 357 with the notation that these data apply to heavier-than-air craft and that many accidents date back to the very beginning of organized control of civil aeronautics when many airplanes in military service were of war-time origin. Many pilots and planes were previously unlicensed and not subject to regulation by the Department of Commerce. Wooden propellers were largely used and systems of training were inferior to those of the present day. Landing fields and navigation aids as today developed are important aids in reducing accidents.

And what is a kiss, when all is done?
A promise given under seal—a vow
Taken before the shrine of memory—
A signature acknowledged—a rosy dot
Over the i of Loving—a secret whispered
To listening lips apart—a moment made
Immortal, with a rush of wings unseen—
A sacrament of blossoms, a new song
Sung by two hearts to an old simple tune—
The ring of one horizon around two souls
Together, all alone!
—*Edmond Rostand.*

The engine failures may be considered high, subject to the further consideration that the report covers equipment not representative of the later engine improvements and the beneficial effects of the testing at the Bureau of Standards. Other data has been included for reference purposes.

The Dornier "Do X" Flying Boat

The "DoX" was described by Mr. Claude Dornier in a lecture before the Wissenschaftliche Gesellschaft for Luftfahrt in November, 1929, and much of the following information was obtained from a translation of this lecture; (N. A. C. A. Aircraft Circular No. 109). The "DoX" was built at the Dornier Aircraft Construction Co., at Alteurbeim, Germany, and required 570 days for its completion (first trial flight on July 12, 1929). The original control hull was later supplemented with additional floats to improve the stability. The hull has three separate decks; the upper or control deck with rooms for radio and auxiliary engines, the middle passenger deck, and the bottom deck for fuel, provisions, and freight. The semicantilever wing has three spars on each side which possess exceptional rigidity and torsional strength. Damage to one of the struts will not endanger the carrying capacity of the whole system. The wing span is 157.48 feet with a chord of 31.17 feet. The total wind area, including the ailerons and upper wing, is 5233.4 square feet. The upper wing is primarily to stiffen the engine bearers. The engines were mounted above the main wings to increase the wing lift.

The original engine installation consisted of 12 Siemens - Jupiter air-cooled engines of 500 B.H.P. each. These were fitted with 2 to 1 reduction gears. The engines were 5.75″x7.50″, 9 cylinder, fixed radial type. Tests were made for the engine bearer stresses as developed by the combined action of thrust, torque, and weight. Independent control of the starboard or port group of engines is provided. A free wheel mechanism between the propellor and the engine permits stopping an engine without incurring increased drag from a stationary propeller or having the idling propeller rotate the engine. Two mean revolution counters give the average r.p.m. of the port and starboard groups, respectively, and 12 small electric lights indicate whether engines are operating. Engines are started by compressed air provided by a small gasoline engine which also produces all the electric current required for the boat. (Note: This engine was located in the wing and has been reported as the cause of the fire which recently destroyed one wing.) Eight gasoline tanks having a total capacity of 4227 gallons were placed directly on the floor of the hull and an elaborate system of piping with three main pumps as well as other smaller pumps insure reliability and flexibility of fuel delivery to the engines. All parts are accessible during flight. The oil tanks in the wings have a capacity of 423 gallons, thus maintaining the customary 10 to 1 ratio of fuel to oil.

The estimated maximum and cruising speeds were 133 and 109 M.P.H. with a total full load of approximately 114,000 pounds.

The power equipment was later changed to 12-600 H.P. Curtiss Conqueror engines of 5.125″x6.25″, 12 cylinder, water-cooled, 60 degree Vee type. In addition to increasing the total horsepower over 1000 H.P., there was the advantage of overcoming cooling troubles presented by the rear engines in the original air-cooled installation.

The Caproni Biplane (Italian)

The Caproni "90 P.B." Military Airplane is described in N. A. C. A. Aircraft Circular No. 121 from "Aeronautics," April, 1930, and "Bolletteno Aeronautico," No. 1-3, January-March, 1930, published by the Caproni Aeroplane Co., Milan, Italy, from which most of the following data has been received. This giant biplane is powered with six Isotta-Fraschini "Asso 1000" engines having steel cylinders, aluminum cylinder heads, and elektron crank cases. These are 18 cylinder water-cooled engines, having 5.91" bore and 7.09" stroke and rated at 1000 H.P. at 1650 r.p.m. The weight with the propellor boss is 1770 pounds. The engines are arranged as three tandems and use direct drive propellers (two blade propellers for the front engines and four blade rear propellers for the second engines). One pair of engines is mounted directly over the center line and about midway between the two wings. The other two pairs are directly over the lower wing to the right and left sides respectively.

This is one of the largest if not the largest land plane ever made and had its first trial flight in October, 1929. By considerably increasing the weight it may be converted into a convertible sea or land plane. It was designed as a protected bomber with seven machine guns and racks for 1764, 1102, 551, and 220 pound bombs (totaling 17,637 pounds of explosives) for normal flight ranges. It has a high speed of 127 M.P.H. and a low speed of 56 M.P.H. with a 14,764 foot ceiling and 7 hour endurance. The upper wing has a 114.5 foot span and the lower wing a 152.8 foot span.

Propulsion by Reaction

In a recent paper given before the Societe Francaise de Navigation Aerienne, Maurice Roy gives some interesting deductions upon propulsion by reaction, as for instance the contemplated rocket flights beyond the limits of atmosphere. There have been recent proposals to reduce exhaust noises by conveying the exhaust gases through hollow propellor blades. If the gases are conveyed to the end of the blades we have a revolving rocket having reaction possibilities. The construction leans to the independent proposals of some gas turbine designs. Mr. Roy considers various phases from a mathematical viewpoint, including the condition wherein the engine does no work but is connected with a turbine. He gives figures for various speeds up to 435 M.P.H., showing total efficiencies around 8%, which obviously prevents economic application. He adds that at speeds above 620 to 932 M.P.H. some of the fundamental objections for explosive rockets may be overcome. The author concludes with the statement that the reaction power plant cannot impair the supremacy of the combination of a heat engine and a propellor except beyond the ranges of speed attained in modern flying.

Editor's Note: This is the last of a series of two articles by Professor Daniel Roesch on Aircraft Engines. The first appeared in the January issue of the Armour Engineer.

Again people talk excitedly of "burning air"

When a public display of gas lighting was given in London in 1802 to celebrate the Peace of Amiens, people talked excitedly of burning air. Napoleon called it a grand folly, and Sir Walter Scott wrote that the world was going mad.

Thus was ushered in the era of gas illumination. It lasted for 75 years. Then electricity stole the field and the gas giant dozed through a quarter century, used chiefly for kitchen cookery.

Now it reawakens in a changed world, to new possibilities, greater opportunities. Eighty thousand miles of pipe lines already laid, extensively equipped with Crane valves and fittings, prove that the old problem of transportation is solved. Pipe lines crisscrossing the country as numerously as electric power ones are freely predicted.

What has brought this second greater gas era? Piping materials! Thanks to these, gas is piped from isolated natural gas fields to users everywhere.

No matter what field of engineering you take up on graduation, you will find its future and its growth interwoven with the development of piping materials. And, as in the past this development has, time after time, been first reflected in the complete Crane line, it will pay you to keep in touch with Crane research and Crane materials.

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Fire Hazards in Airplane Hangars

(*Continued from page 85*)

fires is obvious. The occupancy is extra-hazardous, because of the ready combustibility of the planes and the flammability of fuel, "dope" lacquers, and paint which are in common use and frequently without proper safeguards, such as adequate ventilation and elimination of spark or flame-producing devices. . . ."

It is apparent that the ignition of flammable vapors is the cause of the greatest number of hangar fires, and to reduce this hazard the quantities of volatile liquids must be reduced to a minimum, and all open flames, sparking devices, and processes involving them should be cut off from the sections where the volatile liquids are present.

The Committee on Fire Prevention and Engineering Standards of the National Board of Fire Underwriters prepared a code for the construction and protection of airports. Two conferences were sponsored by the Aeronautics Branch of the Department of Commerce between representatives of the National Board of Fire Underwriters and the aeronautic industry. While substantial agreement resulted on most of the requirements in the proposed code, the representatives of the aeronautic industry objected to the provision requiring the installation of automatic sprinklers in hangars where the areas exceeded a prescribed figure. The representatives of the aeronautic industry took the stand that water would not be an effective extinguishing agent in hangar fires, because, if gasoline were leaking from a plane, the water would spread the burning gasoline and set fire to adjacent planes. They also believed that the high combustibility of the airplane wings and the fact that the planes were stored with their wings overlapping precluded the possibility of extinguishing such fires with water. The National Board representatives took the opposite point of view and contended that application of water from automatic sprinklers would be effective. The National Board agreed to postpone the issuance of this code of Recommended Good Practice Requirements, pending the completion of a series of tests to determine the effectiveness of the automatic application of water by sprinklers in controlling such fires.

These tests were conducted at the Bureau of Standards, Washington, D.C., April 22 to May 2, 1930. A test hangar of wood frame construction was built especially for the tests. Old airplanes which were unairworthy and condemned were furnished by the Army and Navy. The test hangar was equipped with a sprinkler system which could be converted into any one of four systems, namely:

(1) Dry pipe.
(2) Wet pipe.
(3) Open overhead sprinklers with heat actuated water supply valve releasing mechanism.
(4) Same as (3) with the addition of floor spray nozzles, with the same type of valve releasing mechanism.

Lincoln and Davis

From out the fading mists of war two shades appear today,
With clasped hands bridging o'er the gulf where rolled the civic fray—
The Commoner, whose wisdom made a nation truly great,
And he who taught his hosts to love the sovereignty of State;
And both were of Kentucky's soil, divided though they stood,
And each believed his cause was worth its baptism of blood;
But now the stress of war is gone, and from its clouds appear
Our reunited sons again—in spirit both are here.

—*Charles Hamilton Musgrove.*

It was possible to make tests representing only a few of the many possible conditions of origin and spread of fire in hangars. However, the committee tried to produce conditions which were typical of those which commonly exist therein, twelve tests in all being conducted. The committee found that under ordinary circumstances, any type of sprinkler system, installed and maintained properly, would be effective. Under more severe conditions, it was decided that open sprinklers controlled by a thermally operated valve were faster, surer, and more effective than the other types. The following conclusions were expressed by the committee:

1. "Slow-burning fires in well ventilated buildings with high ceilings may continue without opening automatic sprinklers.

2. "Extremely fast fires in single planes may burn themselves out without opening automatic sprinklers.

3. "Fires in readily ignitable and highly combustible materials spread over wide areas, such as gasoline on the floor or highly flammable wing surfaces, may proceed at first faster than the opening of sprinklers and thus outrun for a time the application of water to the fire.

4. "Water from overhead sprinklers may on some occasions keep the top surfaces of an airplane wetted, thus preserving a shelter under which a fire may spread to various parts of the machine. Under this condition, supplemental equipment, such as hand extinguishers or hose streams, could be brought into use effectively. The use of floor sprinklers might reduce the spread of fire. None of these should be permitted to deprive overhead sprinklers of the water necessary for their effective operation.

5. "Each sprinkler installation should be equipped with suitable alarm devices in order that additional fire-fighting appliances may be on hand as promptly as possible.

6. "Fires involving large quantities of gasoline or similar fuel may not be entirely quenched by sprinklers alone, but would be kept usually in a subdued condition, making possible close approach thereto with other means for their subjugation. Suitable additional extinguishing devices should be provided to supplement sprinkler systems for quenching these or similarly persistent fires.

7. "Fires in which several airplanes are ignited simultaneously will usually result in the burning of surface fabrics and the ruin or destruction of some of the structural members of all involved, and may damage airplanes closely adjacent to them.

8. "Fire igniting a single airplane, even under highly favorable conditions for quick spread throughout the machine, is usually controlled by sprinklers so as to cause little or no damage to other airplanes stored close to the one first ignited.

9. "The automatic application of water by sprinklers will generally give good protection to airplane hangars and contents, except such of the contents as are involved in the outbreak of the fire.

10. "The advantages of a heat-actuated system of open sprink-

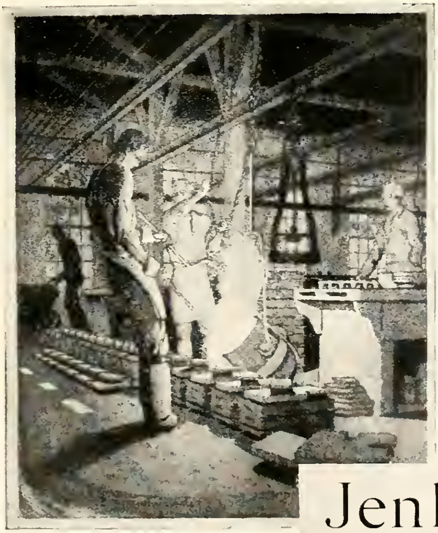
lers such as the one tested are apparent (a) in small or slowly spreading fires, (b) in buildings having high ceilings or conditions of ventilation causing horizontal drafts, and (c) in those fires where the time required for the opening of automatic sprinklers permits the fire to burn out or to get beyond the range of discharging sprinklers.

11. "These tests have indicated that sprinkler systems installed and maintained in accordance with recognized good practice for the protection of this class of property and having an adequate water supply can control most of the fires likely to occur in airplane hangars; therefore serious thought, including thorough economic consideration should be given to the subject of such installations wherever commercial air transport or other aerial activities are carried on."

Other tests have been conducted to determine the value of open sprinklers controlled by heat actuated deluge valves. One series of tests was conducted by the City of Newark at the Colonial Air Transport, Inc. Hangar at Newark, New Jersey on November 20, 1929. In these tests excelsior, gasoline, airplane wings, and fuselages were burned in the hangar, and the kind of protection was interchanged between a wet pipe system and a hangar deluge system. The hangar was also equipped with sprinklers placed in the floor. These consist of 7/16 inch nozzles in conical cups and are protected by hinged covers, which open by the pressure of the water issuing from the nozzles. In some of the tests, these floor sprinklers were brought into use.

It was conclusively determined in these tests that ordinary wet and dry pipe systems of automatic sprinklers are slow to operate in hangar fires, and drafts may prevent the heads directly over the fire from operating. It was found that deluge systems of open sprinklers controlled by devices depending upon rate-of-rise of temperature will operate quickly. The deluge valve operated about 20 seconds after the start of the fire in most of the tests and less than 5 seconds later water was issuing from the sprinklers. There was a separate deluge system in each bay of the hangar, and in all cases the system in the section where the fire originated operated first, followed a few seconds later by operation of the systems in adjacent bays. The issuance of water in the adjoining areas prevented the spread of the fire. The floor sprinklers were found very effective in wetting the lower sides of the airplane wings and consequently were reported to be a valuable supplement to the overhead system.

Other supplementary protective devices such as standpipes, hand extinguishers, wheeled extinguishers, foam generating systems, and carbon dioxide systems are very important and are not to be forgotten in the face of the sprinkler protection. There are, without doubt, many other precautions and methods of protection, now only in the experimental stage, which will be developed by fire protection engineers in the future.



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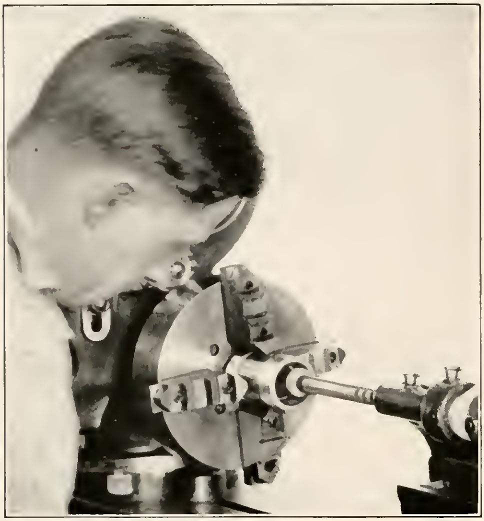

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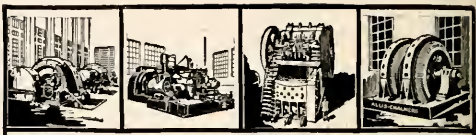

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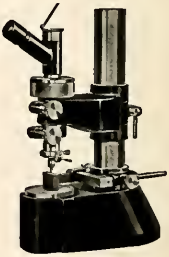

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GLUE

.... In Industry

THE manufacture of glue is an industry as old as the ages. The pages of history disclose, three thousand years ago, the cabinet makers of ancient Egypt laboriously putting together the various parts of their handicraft with a crude form of glue, made under most primitive methods.

3000 years ago . . . . Meanwhile the processes of evolution have transformed ancient Egypt into the modern world; research and science has made commonplace to us today that which would have been miraculous in ancient or medieval times; production and marketing methods have advanced to a basis of scientific control;—but glue and glue-making were not a part of this transition.

Thru the ages, glue remained glue, with little regard for the raw material from which it came and the quality of the finished product.

Then a consciousness was awakened to the difference between glues made from the hides of animals and glues made from their bones. Then, gradually, users began to make certain crude tests of various elementary qualities, but these tests relied primarily on the physical senses, and were usually unreliable.

Only a few years ago, comparatively, was glue finally lifted out of crude speculation as to quality and elevated to an exact scientific method of grade measurement. The laboratories of Armour and Company, in cooperation with one other laboratory, were the pioneers who developed the new methods that have since been recognized the world over . . . . and indeed have recently been accepted as standard by the United States Government.

Armour and Company has also pioneered in adapting the form of glue more specifically to the user's needs. For generations, glue was delivered to the user in a flake form. Then came ground glue—only comparatively recently, however. This speeded up his production and was, in many cases, much more practical for his own purpose. Within the last decade, a new process has been invented. It gives the manufacturer glue in the form of a small pearl, combining all of the advantages of both flake and ground glue in a product that permits a further speeding up of production and at the same time guarantees a cleaner and purer product.

Armour and Company were the first to introduce Pearl Glue on a wide scale in this Country and at the present time is the only manufacturer from whom an appreciable supply of this glue is available.

Likewise in marketing practice Armour and Company have left the beaten paths to lead with new ideas.

A staff of trained chemists is maintained for the purpose of contributing the latest thought on good and economical glue practice. Scores of special problems weekly find their way from the manufacturing field to the Armour Laboratories, and painstaking reports are returned giving constructive help.

Out in the field, in addition, Armour and Company maintains chemical engineers who go wherever they are needed, on request, to analyze plant equipment, gluing procedure, and adaptation of grade of glue. Their sole purpose is to give assistance in improvement of finished quality or reduction of manufacturing cost.

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— EMERSON

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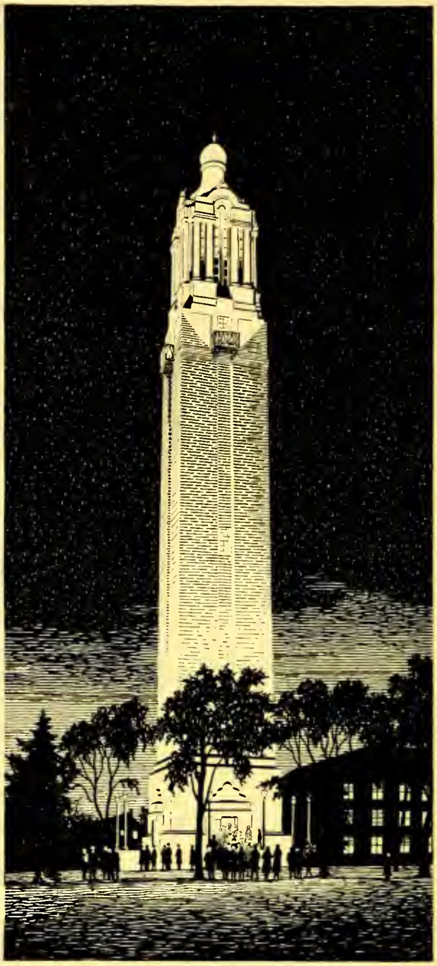

Drawing of the Coughlin Campanile at South Dakota State College, Brookings, S. D. Perkins and McWayne, architects

On THE CAMPUS, where class buildings and memorial structures are so often distinguished by their noble form, floodlighting equipment serves to prolong the enjoyment of their beauty and to enhance pride in the institution. » » Such an application is made for the new 165-foot campanile at South Dakota State — magnificent gift of an alumnus. Electrically operated chimes sound the hours and are heard in concerts. At night, shafts of light from General Electric floodlighting projectors effect a picture of superb beauty done in the school colors and white. From the air, the tower is identified by the beam from a G-E airway beacon surmounting the floodlighted dome. » » Thus, G-E equipment plays its part in promoting progress and fine appreciation. Back of every G-E product is an organization in which college-trained men are largely responsible for the planning, production, and distribution.

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The ARMOUR ENGINEER

VOLUME XXII
No. 4

MAY
1931

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Published in November, January, March, and May, by the College of Engineering, Armour Institute of Technology. Publication office: 3300 Federal Street, Chicago, Illinois. Subscription price, $1.50 per year, postage prepaid. Single copies, fifty cents.

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Claude Irwin Palmer

HIS LIFE WAS SERVICE TO THE COMMONWEALTH.
HE WAS NOT LESS ADMIRED FOR HIS KNOWLEDGE,
WHICH WAS VARIOUS AND PROFOUND:
THAN FOR THOSE QUALITIES OF HEART AND MIND
WHICH MADE THAT KNOWLEDGE PRACTICALLY USEFUL.
PREFERRING THE CALM OF RETIREMENT
TO THE DISTINCTIONS OF PUBLIC LIFE,
HE RATHER SHUNNED THAN SOUGHT OFFICE:
AND WAS AS REMARKABLE FOR DECLINING
AS MANY ARE FOR COURTING ITS HONORS.
BUT, THE APPOINTMENTS WHICH HE DID ACCEPT,
BOTH ELEVATED AND RESPONSIBLE,
WERE DISCHARGED WITH BECOMING ABILITY AND FIDELITY.

The
ARMOUR ENGINEER

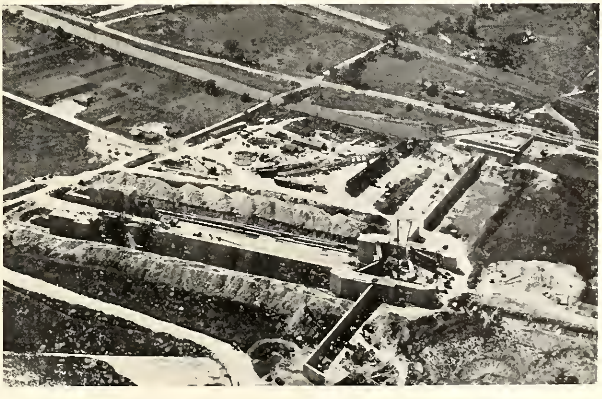
VOLUME XXII MAY, 1931 NUMBER 4

The Development of the Illinois Waterway

By M. R. Beal, '32

Student in the Department of Fire Protection Engineering

WHEN the United States obtained its independence from Great Britain it found itself possessed of a vast natural inland waterway of immense importance covering almost the entire northern border of the states. The Great Lakes forming this waterway system, however, emptied through the St. Lawrence River controlled by a foreign government. Since that date much stress has been laid on the importance and need of a connecting link between this lake system and the Gulf of Mexico. As early as 1808 the construction of a waterway connecting Lake Michigan with the Mississippi River through the Illinois River was urged as an important factor both from a military and a commercial standpoint.



—*Courtesy Chicago Aerial Survey Co.*

Above is a view showing construction work on the Brandon Road lock at Joliet, Illinois.

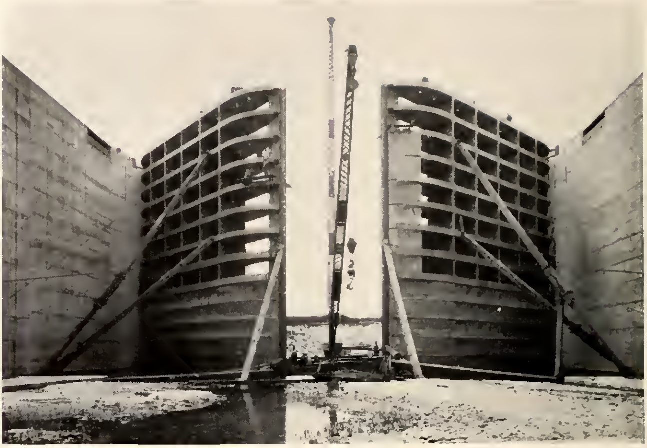
This brief historical sketch indicates the early and intensified interest of the United States in the Lakes to the Gulf Waterway. It has always been the dream of the engineering and commercial interests that someday it would be possible to ship from ports along the Great Lakes to the Gulf of Mexico completely by means of water. To make this possible several improvements were necessary along the seemingly natural route. Foremost among these improvements was the construction of a navigable portion or strip of water from Chicago to a point on the Illinois River. With the aid of such a project it would then be possible to reach the Mississippi River and, further on, the Gulf of Mexico.

Interest in the matter outlined above became intensified to such an extent that, after a great many legislative setbacks, the Illinois and Michigan Canal was started and soon rushed to completion. This small canal was opened to commerce in 1848 at an approximate cost of six and one-half million dollars. Since the completion of this small barge canal, water has been diverted for canal purposes from the Great Lakes watershed, by gravity, to the Mississippi River watershed. Then, as a means of improving the water route, the United States Congress in 1880 adopted the present seven foot project for the improvement of the Illinois River from Grafton, Illinois to the mouth of the Illinois and Michigan Canal. The ultimate object of this improvement was to provide a channelway from the lower end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River boats, so that the products of the country might be carried from the Lake to the Gulf without shifting cargo; also to enable vessels of war of considerable capacity to pass freely from the Gulf of Mexico into the defenseless waters of our northern lakes, should the exigencies of our foreign relations ever require this to be done.

In 1870 the present Illinois Constitution was adopted, under which it was made unlawful to lend state aid to the construction of waterways. It was, therefore, impossible under the existing law to enlarge the canal with state funds in such a way as to make it adequate to meet the needs of modern commerce. Its usefulness as an actual means of transportation decreased and soon became of little consequence as a carrier of freight.

When this condition of affairs was confronted the State appealed to Congress for aid in extending the navigable portion of the Illinois River to Chicago and Lake Michigan by means of an adequate waterway. However, no definite action was taken by the federal government. Therefore, in 1908, the State took the matter into its own hands and placed it before the people, who voted an amendment to the constitution permitting the Legislature to expend twenty million dollars in the construction of a waterway from Lockport to Utica along the Illinois and DesPlaines Rivers. Some work was done following the passage of the amendment but it was not until within the last ten years that the greater portion of the proposed work has been carried out. Considerable difficulty has been experienced by the State in obtaining the needed land for several spans along the intended right of way. However, these are slowly being cleared up, and where work has been delayed for this reason, it is planned to rush completion so that the waterway will be available for commerce in the near future.

The dimensions of the waterway call for a channel with a width of at least 10 feet in rock, with locks 110 feet wide and 600 feet usable length.



The above is a view of the miter gates which are being used on all locks.

In the valleys of the Des Plaines and Illinois Rivers, the construction of the Illinois Waterway will result in raising the water in the various pools to such heights as will overcome the natural current of the streams. There will be five pools between Lockport and Utica. The total fall in this sixty-five miles is 140 feet, and the five locks have a combined lift of 126 feet. Thus a "slope" of 14 feet will provide the downstream current through the 65 mile length of the completed waterway.

At only one or two points is the canal separate from the Illinois or the Des Plaines Rivers. At these sections the waterway consists of an independent canal, but otherwise the dredged river itself will be utilized. There will be locks at Lockport, Brandon Road, Dresden Island, Marseilles, and Starved Rock. With the exception of a distance of two and one-half miles upstream from the Marseilles lock and about two miles downstream from the Lockport lock, the waterway will consist of a series of pools dredged to a proper depth and width wherever necessary. There will also be dams and, later, powerhouses at each of these locks. The Sanitary District of Chicago already had a dam and powerhouse in operation at Lockport before the beginning of work on the Illinois waterway. The headgate structures of the powerhouses, except at Bell's Island, are being built as a part of the dam, the powerhouse being left for a later date.

At Lockport the lock will have a lift of 41 feet. At Brandon Road, below Joliet, the lock is being constructed with a lift of 31 feet. The other locks at Dresden Island, Marseilles, and Starved Rock will have respective lifts of 17, 21, and 16 feet. Thus the total lift in the stretch from Lockport to Utica will be 126 feet.

Between Lockport and Brandon Road the Des Plaines River enters the canal, thus tending to make the level of the water in the Brandon Road pool much higher than a part of the city of Joliet. For this reason it has been necessary to construct walls on both sides of the river extending several thousand feet both upstream and down from the city. The stretch of canal from Lockport to Brandon Road is about six miles.

Miter-type gates will be used at

(Continued on page 144)

A view showing the powerhouse and lock construction work at Lockport, Illinois.

Radiobeacons for Airways

By **Morton Fagen, '32**

Student in the Department of Electrical Engineering

IN vibrant phrases of glowing words the almost incredible story of aeronautics has many times been told. The truly amazing growth from a vague abstraction to its present-day vital economic status has come about in so short a time that there seems to be an inevitable sense of the romantic connected with a consideration of the subject. Imaginative flights of fancy, however, cannot be accepted by us, as engineering students, to either explain or justify the phenomenon; we must attempt to ascertain some concrete basis for it. And seeking, we find.

The debt is acknowledged to science because of its improvement in engine design and physical structure and its utilization in the development of associated equipment to make flying a means of transportation rather than a hazardous venture into the clouds. The application of the radio beacon to airways is the latest of these developments, assuming an importance transcended by none of the others. In effect, it results in hundreds of uniquely marked air lanes traversing the atmosphere, unobstructed by darkness, yet invisible even in daylight. Routes from port to port become as definite as a brilliantly-lighted modern boulevard, yet not a single lumen is emitted from the marker. Apparently, we have to deal with something that is of considerable interest. In this article a discussion will be presented of the genesis of the radio range and of the methods employed in modern installations. Credit for certain technical details is given Messrs. Diamond, Dellinger, Dunmore, Jackson, and Kear of the Bureau of Standards.

The radio beacon in its simplest form might be considered a beam of high-frequency radiant energy, created by the directional properties of the radiating system. It has been found, for instance, that a long, horizontal antenna transmits almost entirely in the direction of the lead-in end, a coil antenna is decidedly directional along its plane, while a vertical wire results in a field-strength diagram which is circular. Since these properties have been known since 1900, it was natural that the early experiments in the employment of radio as an aid to navigation be conducted to utilize them. The result was the radio-compass. Figure 1 (a) illustrates the directional characteristics of a loop antenna, excited from some source of radio-frequency energy. Maximum radiation takes place as shown, while very little occurs perpendicular to the plane of the coil. Conversely, if such a coil is used for reception mounted on a vertical axis free to rotate, a signal from any particular station will be of greatest strength when the loop is pointed toward that station. No response will be observed when it is directed at right angles to the source.

The most serious shortcoming of this method was its duolateral characteristic, since two minimum settings could be obtained for a given signal. The next improvement was the uni-directional compass, wherein the symmetry of the loop was in effect destroyed by combination with a short vertical wire erected along the axis of the coil. The circular characteristic of the latter is added to the tangent circles of the original loop to get a resultant as shown in Figure 1 (b), which is quite markedly uni-directional. This system with some modification is used extensively today in navigation.

At about this time, 1914, another application of the direction-finder was being made with the purpose of enabling a ship not equipped with the radio-compass to learn its position. A group of inter-connected shore stations, each with a direction finder, takes individual bearings on the ship and transmits them to a central control station where the

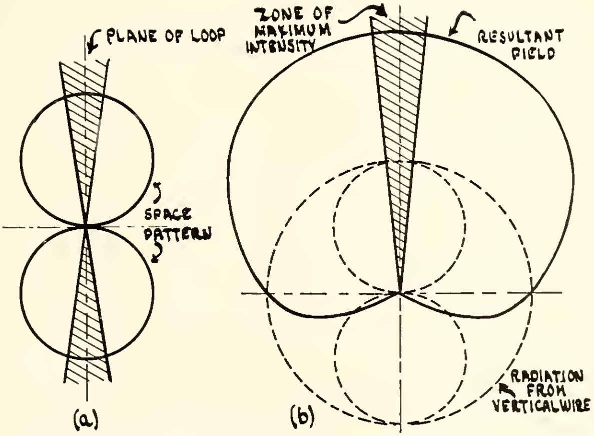


Fig. 1. Above at the left (*a*) is illustrated the directional characteristic of a simple loop antenna. At the right (*b*) this has been modified by combination with a vertical wire.

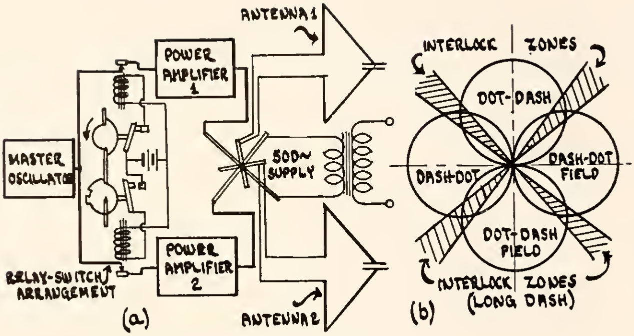


Fig. 2. A schematic diagram of the aural radiobeacon is shown in (*a*). A typical field-intensity pattern for this transmitter is pictured to the right, (*b*).

ship's position is plotted and made known by customary radio communication. This method was rather slow and was subject to the greatest delay in the most unfavorable weather when a number of ships required bearings simultaneously. But it made possible the location of vessels carrying no equipment other than the compulsory transmitter and receiver.

Such was the state of the art at the outbreak of the World War, at which time the first work in applying the radio beacon to air service was begun. It was imperative that military aircraft be supplied with some positive means of direction determination that would function in thick fog, since many operations depended for their success on the utilization of such shelter. To meet this need, the radio-compass system was employed in practically the same form that it had been used on shipboard. With a sensitive receiving set on the plane, it was well adapted for such work where some indication of the home port was the only requirement. It was found, however, that the plane might be shifted off its course by wind-drift, resulting in a serpentine effect on the shape of the route. More objectionable was the necessity of complicated apparatus on the plane itself, requiring attention and care on the part of the pilot or his assistant. Too often, the business of war left no time or inclination for such attention to the equipment.

The next development had also as a basis a method employed in navigation, the second of the two previously described. Each airplane was furnished with a transmitter and receiver for communication with permanent direction-finding stations located at a single landing field. A pilot desiring to learn his position transmitted his request to the field, from which point it was relayed to the various stations. These stations then assembled their observations and sent a reply to the pilot. Today in Europe, every plane in commercial transport service is equipped to take advantage of a quite complete system utilizing such means of course location. As has been pointed out, it has the disadvantage of requiring individual service from at least two stations to each request for position. Further, in aviation the pilot must rely on blind flying during the greater portion of his flight. Since the bearings are infrequent, he travels a route which may or may not be over a regular airway. While for military purposes the last is unobjectionable, commercial transportation is greatly concerned with mapping out and adhering to definite lanes along which markers, emergency fields, and the like may be maintained as a safe-guard to safety and reliability.

Aware of the limitations of the methods then available, the Army Air Service in 1920 requested the Bureau of Standards to undertake a program for devising a new radiobeacon system which would serve as a guide to airplanes flying along a definite course. By 1923, intensive tests were being made on the new method; the aural radiobeacon system had been developed.

Consider two aerials, each possessing directive properties similar to those of loops and arranged at an angle with each other. As we have seen, both will radiate principally in directions parallel to their planes. Along the line bisecting the angle between the two, the intensity of the wave from one will be equal to the intensity of the wave from the second. Now, if one radiation could be distinguished from the other in some way, a pilot equipped with a radio receiver and a pair of phones might keep his craft on such a route in space that both identifying characteristics were present in the same intensity. He would then be following the bisector of the angle between the antennae. This principle was utilized in the original apparatus in which a different signal was impressed on each wave and an automatic switch used to change the input from one antenna to the other.

By 1926 improvements and refinements had taken place which led to an arrangement such as that shown in Figure 2 (a). This employs a signal switching arrangement of slowly-rotating cams so cut that as they revolve, one amplifier tube transmits the letter N (—.) and then is disconnected while the other amplifier tube transmits the letter A (.—). From Figure 2 (b), it is apparent that an observer on the bisecting line hears an interlock of the two, a long dash. If he is not

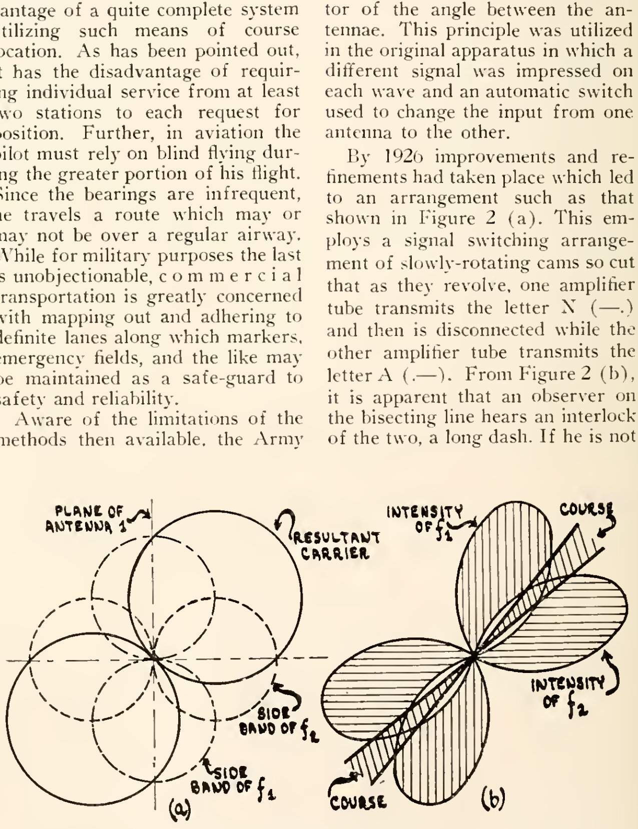


Fig. 3. The diagrams above indicate the space pattern radiated by a double-modulation beacon (*a*) and the characteristic as received (*b*).

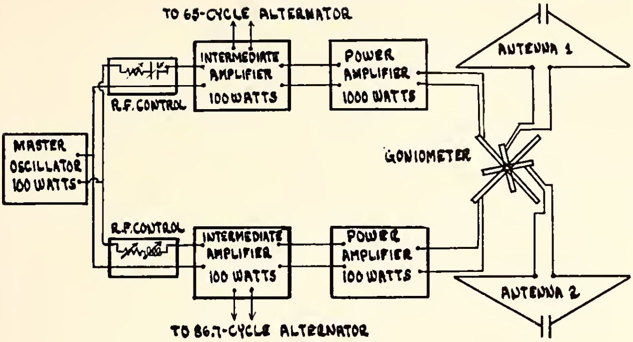

TO 65-CYCLE ALTERNATOR
INTERMEDIATE AMPLIFIER 100 WATTS
POWER AMPLIFIER 1000 WATTS
ANTENNA 1
R.F. CONTROL
MASTER OSCILLATOR 100 WATTS
GONIOMETER
R.F. CONTROL
INTERMEDIATE AMPLIFIER 100 WATTS
POWER AMPLIFIER 100 WATTS
ANTENNA 2
TO 86.7-CYCLE ALTERNATOR

Fig. 4. Above is the schematic diagram of a double-modulation radiobeacon of the four-course type.

on the bisector, the intensity of one signal is greater than that of the other and either the letter A or N will be the more obvious.

The transmitter output is coupled to the antenna system through a 4-coil variometer, known as a goniometer. Connected as in the diagram it has a highly useful and interesting effect on the direction of transmission. It so happens that each of the two primary windings acts as a single-loop aerial of the type that has been discussed. The plane of this equivalent loop, however, is dependent, not only upon the plane of the antenna proper, but on the relative coupling of a primary to the secondary coil of the goniometer. Thus with two primaries there are, in effect, two loops in the radiating system at an angle with each other equal to the angle between the primaries. This angle may be varied quite easily and the equivalent antennae may be rotated in space, changing the position of the equi-signal zones without altering the long wires of the antennae proper which are crossed at 90°. Plate power supply to the one kilowatt amplifier tubes is supplied at a frequency of 500 cycles, giving an easily recognizable modulation to the received signal. The radio-frequency input to these tubes is obtained from a somewhat smaller oscillator working through the interlocking arrangement of cams and relays.

So, for the first time in the history of the radiobeacon, a system especially adapted to airways was developed. To the pilot, it had the great advantage of simplicity, all complicated apparatus being maintained at ground stations under skilled supervision. Observations could be made directly and easily without the need of maneuvering.

In 1926, great stimulus was given to research with radiobeacon systems by the passage of the Air Commerce Act, providing for organization of the Aeronautics Branch of the Department of Commerce. Since the main duty of this new division was to be the promotion and regulation of civil aeronautics, its major problem was to provide some means to assure air-passage service entirely independent of the hazards of weather, so that scheduled flying might be maintained. Once again, the Bureau of Standards was destined to solve the problem by new developments with the radiobeacon. The aural system as we had last seen it provided two pairs of courses at right angles. These might be rotated in space with both courses of a single pair arranged in a straight line through the beacon. In the actual use of beacons along airways the condition met more frequently is that of a bend in the route from city to city. It was necessary, then, to provide means for introducing an obtuse angle of controllable magnitude in the radio range. Two fundamental schemes were devised. The first was to insert a resistance in series with one of the goniometer primaries, reducing the power in one of the antennas. The effect is to shift the intersection of the beacon space patterns and so move one of the courses. By varying the power ratio in the two equivalent loop aerials, the courses may be shifted from the normal right-angle relation to any angle between 45° and 135°. The second scheme was the employment of an additional vertical wire with an effect involving addition of field intensities. It will be remembered that this idea was used in the navigation radiocompass to obtain unilateral directional properties. By adjusting the magnitude of current in the vertical wire, the courses may be shifted to any angle between 135° and 180°.

The possibility of interference between beacon stations was also investigated. This was minimized by two methods. The first of these was to utilize the assigned range of beacon frequencies in such a manner that adjacent beacons emitted signals that were separated by at least 12 kilocycles. Since the selectivity of the aircraft receivers permitted 8 kilocycle separation there was little difficulty involved in distinguishing between the units. The second method was to establish a set of code signals which would enable adjacent beacons to be distinguished, but which would still allow the use of the interlock to produce a long dash on the course. A number of different letter combinations were tried but these were discarded in favor of the N-A signals transmitted in a sequence made up of a number of characters. Thus, one station might send four characters per cam revolution while the adjacent one, perhaps 200 miles away, would send six.

By 1928, the aural radio range had become a highly useful aid to aviation safety and flying efficiency, proving tremendously valuable in adverse weather conditions. Highly encouraging results were obtained from a number of eastern air routes equipped with radio beacons for an investigation of their possibilities. Flights were made that otherwise would have not been feasible, crashes and fatalities were lessened, and a marked reduction in flying time was observed.

Successful as it was, the aural radiobeacon possessed some unsatisfactory features. The pilot was under constant strain in listening to the beacon signals and distinguishing between their magnitudes. Further, the guiding signals might be blanketed by atmospheric disturbances. Early cognizant of these shortcomings, the engineers of the Bureau with the Aeronautics division had been working on a visual means for observing the beacon transmissions at the same time that they were making the final improvements on the aural system. Thus, the double-modulation beacon system was developed.

In the aural radiobeacon it will be remembered that the two loop antennae were excited alternately, one with the Morse character N, the

(Continued on page 142)

Julius Rosenwald

The Rosenwald Museum of Science and Industry

By Prof. G. L. Scherger, Ph. D.

Professor of History and Political Science and Head of the Department

IN beautiful Jackson Park in Chicago, the wonderful building is now nearing completion which is to be known as The Rosenwald Museum of Science and Industry. The founding of this museum is made possible by the princely munificence of Mr. Julius Rosenwald. When completed in 1932, a year before the opening of the World Fair, it will prove to be one of the greatest attractions in the wonderful city of Chicago, not only because of its magnificent architecture but also because of the wonderful collection it will house which is designed to reveal the technical ascent of man throughout history.

The museum is to be patterned largely after the famous Deutsches Museum in Munich, Bavaria, the creation of the famous Dr. Oscar Von Miller, which was opened in the year of 1925 and which is a monument to the devotion and energy of Dr. Von Miller, who is undoubtedly one of the most wonderful men of our age and who succeeded in arousing such enthusiasm for his project among the industrial leaders of Germany that they co-operated with him in making this gigantic enterprise possible by donating machinery and designs, many of which are not only of priceless value, but simply could not be duplicated.

In the Deutsches Museum the various processes of mining are represented in such a manner that the visitors actually descend into the mine and see how the work is done. The various processes of refining the ore are demonstrated as actually carried on in the mines, mills and factories. The equipment in many cases has been prepared and donated by companies actually engaged in this work. Every step is carefully demonstrated from the mining of the ore to the completion of the smelting. The same is true also for coal mining and for the mining of salt. Many famous mines are actually reproduced.

Every other line of technical work is exhibited in similarly thorough fashion such as the development of transportation in all of its phases. Thus the development of the railroad may be studied in all of its stages, there being models of the first locomotives built in England, America, and Germany down to the latest and most improved type of locomotive. In the same thorough way is traced the evolution of boats from the simplest known type used by the savages to the finest constructed vessels. There is an actual submarine demonstrating all of the phases of submarine construction. There are the originals of the earliest and latest airplanes and dirigibles. The evolution of clocks and watches, of musical instruments and the like are shown. The building contains ideal chemical and physical laboratories. In fact, scarcely anything relating to the industrial life of man has been overlooked. Machines may be turned on, often only by pressing a button. Numerous attendants gladly explain any process fully and often go to great trouble in setting the necessary machinery into operation.

What a wonderful opportunity, especially for the young, to acquire a thorough knowledge of the various technical processes! The world-wide popularity of the Deutsches Museum is evidenced by the fact that over one million persons passed through the museum in the course of a single year, although the total population of Munich is only three-fourths of a million. To see the entire collection entails a promenade of about ten miles and yet most of the people enjoy every moment of their visit. To see the collection thoroughly requires many days. Yet Dr. Von Miller is far from satisfied with the work as it now is and proposes, no doubt, to enlarge it.

In Vienna likewise a wonderful technical museum was established, which under the direction of Hofrat Erhard has become a model institution of this type admirable in its span, comprehensive in its scope, and eminently popular in its educational appeal; for Vienna tried to reach the same high standard set by Munich.

Struck by the brilliant success of Von Miller and Erhard and by the fact that, despite its achievements in science, engineering, and industry the United States had nothing to correspond with The Deutsches Museum in Munich or The Technisches Museum in Vienna, Mr. Julius Rosenwald decided to establish not merely an imitation but an institution which would utilize the experience of Europe. He laid his plan before the Commercial Club of Chicago, which is composed of representative business men, and in 1926 expressed his willingness to endow an American Technical Museum with the sum of three million dollars to be spent for equipment alone. The Club formed a board of trustees and undertook the task of creating the museum and administering the fund. The city likewise responded most generously.

In Jackson Park stood the old Fine Arts Building, a disintegrating reminder of the World's Columbian Exposition of 1893 and an architectural masterpiece which in the words of the late Augustus Saint Gaudens "is the finest since the Parthenon." The South Park Commissioners were authorized to issue bonds to the value of $5,000,000 for the purpose of reproducing the structure in permanent form so that it could safely exhibit scientific and technical collections which, if the Deutsches Museum is a criterion, will ultimately be so large that they will be worth at least $30,000,000.

Thus was born the Museum of Science and Industry founded by Julius Rosenwald. By the summer of 1929 the work of erecting a replica began.

At the present moment the work of reproducing the structure of The Old Fine Arts Building, which is being carried on by the R. C. Wieboldt Construction Company, has progressed so far that visitors in Jackson Park may already realize that the whole world probably has no building that will surpass it in architectural beauty. It is hoped that in 1933, at the opening of the great Chicago Fair, the museum will not only be completed, but actually open to the public, although there is no intention of filling by that time halls as vast as those of the large Deutsches Museum.

The new museum will not simply duplicate the famous collections of the old world but take a forward step by illuminating the social and cultural aspects of science and technology. It will aim to show what the new scientific materials and inventions mean in our modern life. The harvester and reaper, locomotive and steamships will cease to be merely ingenuous combinations of machine elements but will become saviors of the human race.

Similarly, the effect of the new discoveries and inventions as factors in staving off disease will be elucidated. The introduction of the steam engine gave us the factory and mass production and the steam engine in turn made it necessary to huddle masses of humanity in industrial centers. Social problems were presented which could be solved only by science, without whose aid tuberculosis and typhoid fever would make it impossible to house workers decently or to provide them with the clean, well lighted factories and offices in which they now work. The bacteriologists of the sanitary engineering are doctors of civilization.

Similarly, chemistry will be presented both as a technical aid and as a social and economic force. We are now passing almost unconsciously through a chemical revolution. In the Museum of Science and Industry we shall see the chemist not only mimicking nature in the factory but tearing matter apart and reassembling its constituent atoms into compounds unknown in nature. It is not enough to trace thousands of drugs, perfumes, flavors, photographic developers and explosives back to coal tar. We must also connect coal tar with the

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Here is shown an artist's conception of the Rosenwald Museum as it will appear when completed.

A New Force in Industry

By F. B. Attwood, '31

Student in the Department of Chemical Engineering

A NEW force is being made available to the engineer of the future through the development of a substance known as "silica gel" a material that harnesses the property of capillary action.

We are all familiar with the common phenomenon of capillary attraction or absorbtion which occurs when the corner of a blotter is put in a drop of ink and the ink flows up the blotter in defiance of gravity, or when a sponge soaks up water. Another phase of capillarity known as adsorbtion is the property taken advantage of by silica gel. If the pores of a sponge were reduced to a billionth of their present diameter, they would have such intense capillary attraction that they would drink in, not only water, but vapors and under proper conditions, gases, and hold them just as a sponge holds water. The structure of silica gel gives it such properties as these.

Chemically it is the same as sea sand, but physically it is entirely different. It is honeycombed with ultramicroscopic pores which have a diameter about ten times that of a single molecule. This gives the substance an enormous surface area, a one-quarter inch cube having an area of five thousand square feet. Since the property of adsorbtion is a function of the surface, the adsorbtive capacity of the gel is astounding.

The industrial uses of the substance are widespread, and the development of further applications is being carried on at the present time. For the purpose of discussion the applications will be grouped under the following heads:

1. Dehydration
2. Air conditioning
3. Refrigeration
4. Refining
5. Solvent recovery
6. Catalysis
7. Miscellaneous

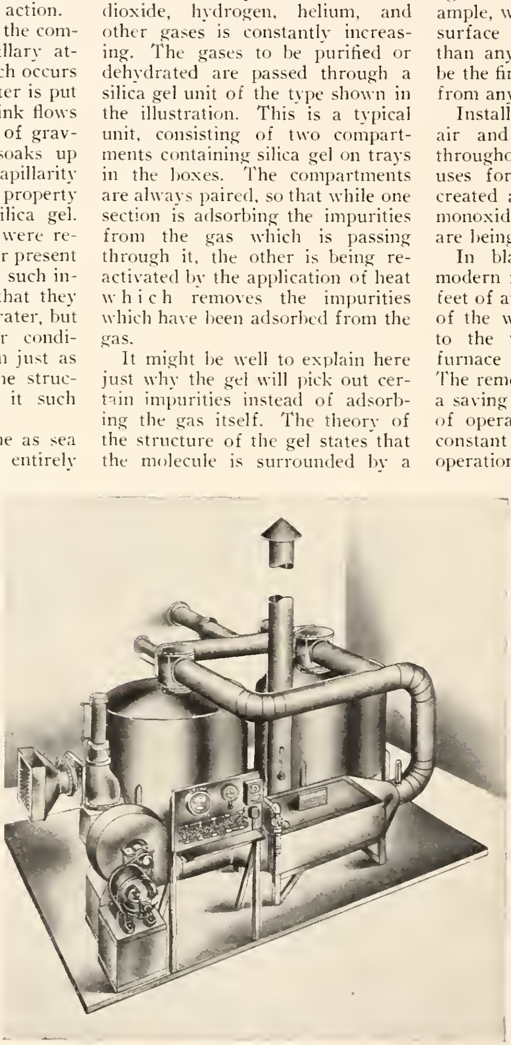

Fig. 1. Here is shown a silica gel dehydration and purification unit for the low pressure process.

Dehydration

The demand for practically anhydrous and purified air, carbon dioxide, hydrogen, helium, and other gases is constantly increasing. The gases to be purified or dehydrated are passed through a silica gel unit of the type shown in the illustration. This is a typical unit, consisting of two compartments containing silica gel on trays in the boxes. The compartments are always paired, so that while one section is adsorbing the impurities from the gas which is passing through it, the other is being reactivated by the application of heat which removes the impurities which have been adsorbed from the gas.

It might be well to explain here just why the gel will pick out certain impurities instead of adsorbing the gas itself. The theory of the structure of the gel states that the molecule is surrounded by a film of moisture. If placed in a mixture of gases or vapors, that gas or vapor will be adsorbed first which has the least surface tension against the water film. For example, water naturally has a lower surface tension toward the film than anything else, and hence will be the first substance to be removed from any mixture.

Installations for the drying of air and gases have been made throughout the country. The new uses for so-called dry ice have created a demand for dry carbon monoxide, and many silca gel units are being used for this purpose.

In blast furnace operation, a modern furnace takes 60,000 cubic feet of air per minute. The raising of the water contained in this air to the temperature of the blast furnace represents a serious loss. The removal of the moisture means a saving in fuel and a greater ease of operation because of the more constant conditions. Figures on the operation of a silica gel unit on a blast furnace for twelve months show an increase in output of 15% and a fuel saving of 4.7%.

Air Conditioning

Air conditioning is of vital importance in many industrial plants, especially those engaged in the manufacture of telephone cables, drugs, and cork. Silica gel units are used in these industries and are so efficient in their removal of moisture that the air supplied is 14 per cent lower in humidity than the air over the Sahara desert. Yet workmen can work comfortably in the rooms to which this air is supplied.

Conditioning of air for comfort and health is a field which has come into prominence in recent years. The usual method of cooling has been to spray the air,

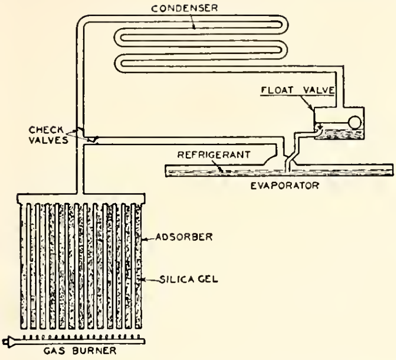

Fig. 2. This diagram illustrates the principle of silica gel as a refrigerant.

resulting in a cooling effect that had a chilly, clammy effect. The removal of the excess humidity by silica gel units has been successfully tried out and the air supplied has none of the disagreeable effects. Small installations making use of the hot air heating ducts in the home are being experimented with at the present time.

A hospital in New York has a conditioning apparatus that removes the carbon dioxide and moisture from the air, making it possible to control precisely the composition of the air which is supplied to a small room by the use of supplementary gas tanks. The room is used in the treatment of pneumonia and other respiratory diseases.

Refrigeration

At a meeting of refrigeration engineers last year, one engineer suggested to another that, "It looks like a handful of sand is going to put a lot of us fellows out of work." While it is not expected that the adsorbtion system will entirely replace the compressor used in the ordinary refrigerator, it is true that the adsorbtion method has a place in the field that will not be denied.

The principle of the refrigerator is identical to the so-called mechanical type, but instead of a vacuum pump and compressor, the twin silica gel units in turn adsorb the vapors of the liquid refrigerant and then when saturated, by manipulation of the proper valves, give it up to be recirculated. The principle can be understood by reference to the diagram.

The special field in which this type of refrigeration is likely to make advances is that of refrigeration in railroad cars. Ordinary mechanical refrigerators will not stand the rough treatment of the switch yards, while it has been proved that the adsorbtion systems can hold up. Automatic timing devices are used to control the adsorbtion and activation cycles, and when trouble does appear, it is in this mechanical timer. Propane gas is used for heating, and is stored in liquid form in tanks beneath the car. The advantages over icing are numerous; lower temperature, more uniform temperature, more shipping space, and no dripping of brine or water are the most important.

Applications of the system have been made to trucks and apartment houses with success, but there has been no unit made yet for the small home.

Refining

The conventional method of refining light oils from coke oven gas has been to mix the oil with sulfuric acid, allow it to settle, decant the supernatent liquid, neutralize, and distill. The disadvantage of this method is that the sulfuric acid, besides removing the sulphur compounds and gum-forming contitutents, also attacks the unsaturated hydrocarbons which have valuable anti - knock characteristics.

Four leading oil companies are now working on the use of silica gel for the removal of the impurities. The crude oil is slightly acidulated with sulfuric acid and forced through the gel at 275°F. and 50 pounds per square inch pressure. The sulphur and gum - forming compounds are removed by this treatment while the unsaturated hydrocarbons remain intact.

The first commercial plant was set up at Rochester, New York. The results after a year's operation show the yield of salable motor oil increased 13 per cent with a cost increase of ¾ cents per gallon of crude oil. It is claimed that the plant paid for itself in one year.

This report is inclined to be optimistic, it seems, because other companies are slow to make similar installations on the grounds that the product obtained is not so desirable as that obtained by the earlier method.

Solvent Recovery

In the manufacture of rubber goods, leather, artificial silk, etc., solvents such as alcohol, ether, and benzol are used and later eliminated by evaporation. These solvents must be recovered completely and efficiently because of the competition in these fields.

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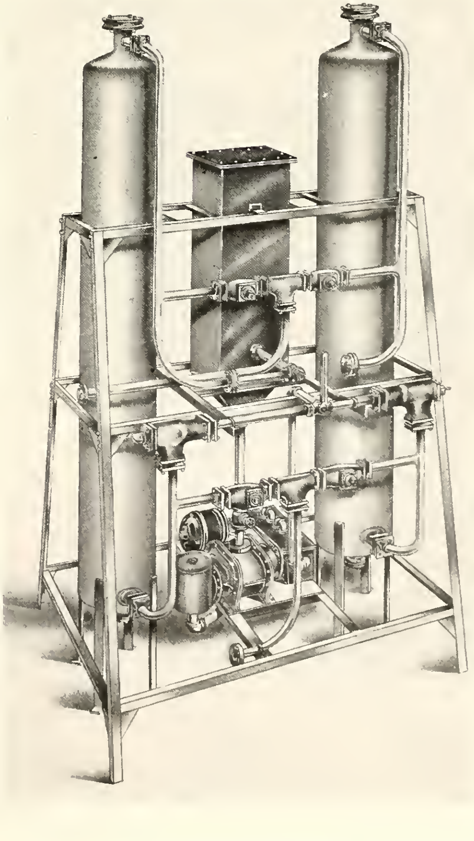


Fig. 3. This view shows a silica gel dehydration and purification unit for the high pressure process.

ENGINEERING NEWS

A Precision Clock Developed

A new precision clock, which varies from the correct time not more than one five-hundredth of a second in twenty-four hours, has been recently constructed.

The most distinctive feature about this clock is the addition of a very considerable mass of metal to the upper end of the pendulum, so arranged that its center of gravity is exactly opposite the knife-edge bearing on which the pendulum is suspended. This provides a greater steadiness of swing of the pendulum, and is the principal contribution to the clock's accuracy.

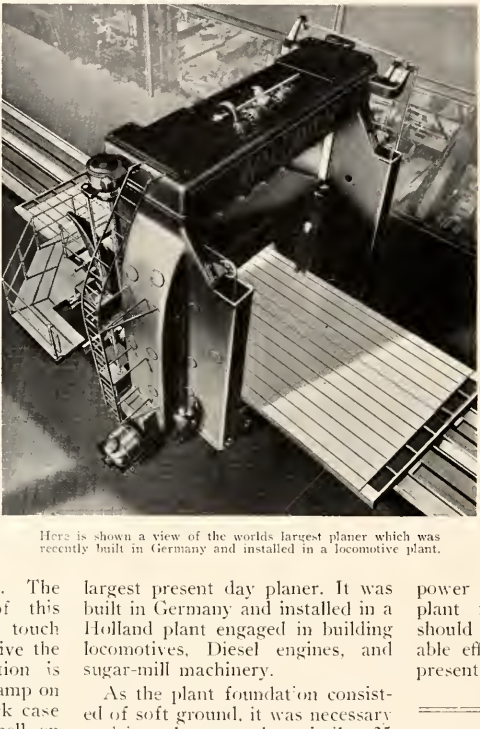
In order to prevent changes in length of the pendulum as far as possible, the clock is kept in a room in which the temperature is regulated, and any changes that do occur are automatically registered. To reduce atmospheric friction to a minimum, the clock is kept within a sealed glass case filled with hydrogen.

The precision clock does not have a face and hands, but by electrical connection to a second clock the time is registered. The face-swinging pendulum of this master clock does not even touch the electric contacts that drive the second clock. Communication is done by beams of light. A lamp on one side of the master-clock case shines on a photoelectric cell on the other. Every time the pendulum swings, it causes a momentary eclipse of the photocell. This causes an electric current to flow for a moment, giving the second clock the necessary push to keep it going.

The slave clock, as it is called, thus admonished to accuracy from second to second by its master, repays by closing a circuit with each swing of its pendulum, which supplies a momentary electromagnetic impulse to the master-clock pendulum, keeping it swinging.

The Largest Planer

An engineer's design is generally one of good operation in the smallest possible space. Though this is the usual rule, there are times when the use of huge machinery must be considered. An example of this is shown in the accompanying illustration of Europe's largest present day planer. It was built in Germany and installed in a Holland plant engaged in building locomotives, Diesel engines, and sugar-mill machinery.



Here is shown a view of the worlds largest planer which was recently built in Germany and installed in a locomotive plant.

As the plant foundation consisted of soft ground, it was necessary to drive a large number of piles, 35 feet in length, into the ground in order to provide a firm support for the planer.

The machine will plane work 15 feet wide and 40 feet long. The total floor space occupied is 30 by 86 feet. The table alone weighs 70 tons. The planer is driven by two direct-current reversing motors of a 120 horsepower capacity. The cutting and return speeds are independent of each other, and can be varied from 13 to 130 feet per minute. There is a rather unique push-button control system used in regulating the table motion and the length of stroke. The latter may be made as short as two inches. The table speeds are so arranged that an intermittent slow motion may be obtained while cutting, the table being speeded up between two castings when the tool is cutting air. The feed of this machine may be varied from 1/16 to 1¼ inches. This is an indication of the weight of the material that may be planed in a given time.

A Windowless Factory

Windows have been a boom to man ever since the beginning of time. Now we are introducing a windowless building; this means a structure utilizing artificial light. Can we even hope to do as good a job as Old Sol? Time will tell.

A present day factory is being constructed essentially for experimental work with this idea predominating. Illumination will be furnished from hundreds of 1000 watt incandescent lamps, flooding the entire building with light of uniform intensity. Of course, a windowless building also means an artificial means of ventilation must be installed. This, however, is quite easily accomplished.

The general adoption of this new idea offers interesting possibilities to the operating engineer. With a steady lighting and power load during the day, with the heating and ventilating requirements, and with possibly an air-conditioning and cooling system for summer operation, it should offer new problems in the design of an individual power plant. The private power plant for this class of service should show a much more favorable efficiency than it does at the present time with its variable loads.

Studying Earthquakes

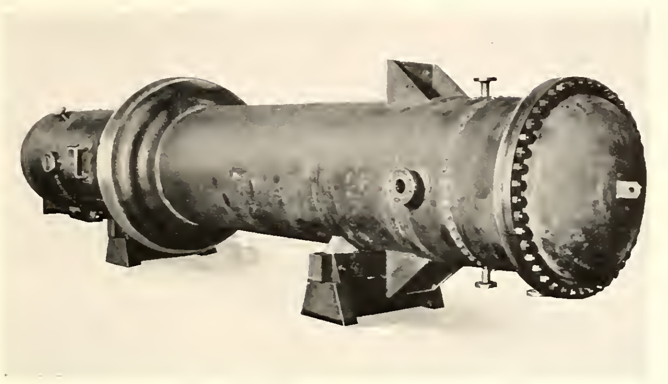
An attack on the earthquake problem is now going on in this country, Japan, and other parts of the world. It includes practically every field of interest from the interpretation of seismograph records to the design of dams and other structures. With all its comprehensiveness there is one serious gap—we do not know exactly what goes on. Observers tell us what they have seen, but eye - witnesses are rather unreliable under stress. Records left in buildings and in the earth itself are invaluable, but they do not tell us just how the results were brought about.

The engineer is now demanding this information from the seismologist. The latter can obtain this by modifying existing seismographs so that they will give the desired record and not be destroyed (unless the building containing them is demolished). Effort is being made to secure the most complete record possible at the lowest cost.

Even with instruments in operation it is very difficult to interpret the records. Complete data by sensitive instruments is now being obtained in southern California. The records give the time required for the earthquake waves to travel to the instrument, yet it is difficult to locate the earthquakes with the desired accuracy. This is caused by the different geological formations affecting the path and behavior of the waves. Surface layers affect earthquake waves.

The complex action recorded at the center disappears directly as the distance from this center, and though there be several shocks the greatest outburst sends its energy the furthest. It is also known that the earth tilts in the central region of an earthquake during the entire period from one earthquake till the next, first in one direction and then in the other.

All of this is evidence as to what happens. But what causes such happenings?



Above is illustrated a preheater exchanger used in the oil refining service which has only recently been made possible by a new arc welding process.

Arc Welding for High Pressure

Until lately, the use of arc welding in the fabrication of pressure vessels has not been permitted by either the insurance codes or the laws of many states. This restriction was due to the uncertainty of welds during the early development of the process.

Recent research along experimental lines has aided the engineer in using such fabrications for practical purposes. The shielded arc process will economically produce welds having a tensile strength of from 60,000 to 75,000 pounds per square inch and a ductility at least equal to that of rolled steel. This has removed the barrier that prevented the use of the electric arc in the producing of pressure vessels. The illustration shows one of twenty preheater exchangers for oil refinery service, in the fabrication of which arc welding has played an important part. These containers are subjected to a 200 pound per square inch pressure at 750 degrees Fahrenheit. They weigh 17 tons each and are 29 feet long.

Flame Analyzer

An instrument designed to check the heating effect of fuel gas has been recently devised. With the aid of this instrument it is possible to measure, record, and automatically control the heating effect of any gas. When it is necessary to enrich a lean gas or dilute a lean gas, the flame analyzer makes it possible to observe and record the quality of the output and gives automatic control of the mixture, insuring a uniform product.

Cylinder Repair by Grinding

In numerous observations in the Southwest among oil and gas companies operating thousands of engines, a preference is shown for the ground cylinder in repair practice. It appears that from every point of view the ground cylinder for gas and oil engines is far superior to cylinders bored with a cutting tool. Experience shows that the period of service (between grindings) rendered by the ground cylinder is greater than that between borings and is due solely to the superior service and wearing qualities of the ground cylinder.

When bored with a cutting tool, the cylinder starts its period of service with a minutely corrugated surface which must be worn to a glaze by the friction of the piston and rings. On the other hand, the ground cylinder begins its period of service presenting its full surface area in contact with the piston and rings.

In the ground cylinder, this desirable glazed surface is produced by the grinding wheel and not by fractional wear as in the bored cylinder. It is this same friction that causes excessive heat and destroys the lubricant. These two are the common causes of scored cylinders and cracked pistons.

Clearance between the ground cylinder and its piston remains the same until natural wear gradually increases it, while the clearance between the bored cylinder and its piston increases rapidly until the corrugations are worn off and the glazed surface is formed. Accurate measurements of a cylinder carefully bored with a tool and then ground show that the diameter increases at least 0.004 of an inch before the proper glazed surface is obtained.

When a repaired cylinder is installed, it is necessary with a bored cylinder job to spend some time "running in" the cylinders in order to prevent piston seizure. On the

(Continued on page 137)

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

VOLUME XXII | MAY, 1931 | NUMBER 4

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Make The Armour Engineer the best technical college publication in the country.

> *It ought not to be the leading object of anyone to become an eminent physician, mathematician, or poet, but to render himself happy as an individual, and an agreeable, a respectable, and a useful member of society.*
>
> —DONALD STEWARD.

THE STUDENTS AND faculty of the Armour Institute of Technology have recently been thrown into a deep bereavement. Two of our most esteemed leaders and professors have passed on. These two men who are lost to us are Dean Claude Irwin Palmer and Professor Alfred Edward Phillips.

Dean Palmer was Dean of Students, Professor of Mathematics, and Head of the Department of Mathematics. His ability as a professor of mathematics was unsurpassed. As dean of students he gave to all those who went to him, sound advice and help. His character, leadership, and personality were loved and respected by everyone. His guidance for the students in their times of distress was as a light on a dark sea guiding the fugitive to safety.

Professor Phillips was Professor of Civil Engineering and Head of the Department. His superior intellect made him a most excellent instructor, and his wealth of knowledge in civil engineering made him an outstanding man in that field. He was loved by his students because of his friendliness and good spirit. He always had a kind word and a smile for his students as well as for all with whom he dealt.

These two men, though now lost to us in this worldly existence, have passed on into a school far greater than any of us can now realize. We mourn their passing. We mourn the emptiness which their passing leaves. For a few short years the rest of us must carry on without them. But their spirits will ever be with us as an inspiration.

IN JUNE ANOTHER SCHOOL year will come to an end. The thoughts of the students now turn to plans for the future. For some the future is the long journey through life, with its opportunities, its disappointments, and its vicissitudes. Those seniors who will be graduated and will start to make their fortunes may wonder what the future has in store for them. They may wonder to what avail they may use the training which they have received during their years in preparatory and college institutions.

Whatever have been their lines of endeavor, whatever will be their positions in life, the valuable foundation obtained from the study and energy given to their college educations will be of inestimable value.

Perhaps most of the innumerable things which they learned, and so carefully studied and thought out may be forgotten. The value of the college education, however lies in the quality of having learned to think. Those who have completed their college courses and have gleaned the most from them have learned to think. To know how to think is the greatest step toward success.

IN THIS AGE OF SWIFT development and advancement in every phase of business, it is necessary for all of the important industries to keep abreast of the times. One of the biggest cogs in our daily life is the railroad industry, upon which most of the commerce and business of the country is dependent. But the railroads have not kept in step with the progress of the other giant industries. The reason for this is that they have not been financially able to do so.

According to Mr. Agnew T. Dice, President of the Reading Railroad, the railroads should handle the increased tonnage of today with the newest and most efficient tools. The chief one of those developed within the past few years is the electric locomotive. It can haul heavier trains at higher speeds with much higher efficiency than the steam locomotive; it can be kept in service a greater part of the time; it can utilize hydro-electric energy; it requires less men to operate it; its weight is less; and it can be maintained and serviced at less cost. These advantages and many others are forceful arguments in favor of electrification of the railroads.

Up to this time the railroads, however, have not had the funds necessary to undertake this great change. Mr. Joseph Eastman of the Interstate Commerce Commission says that the test of whether the railroads are being paid enough is their ability, under good and honest management, to attract new capital to meet the needs of development. The Reading Railroad seems to have done this for it is now spending $20,000,000 in electrifying its suburban lines in the vicinity of Philadelphia. Perhaps other of our railroads will show their initiative in the near future and make this great step toward keeping abreast of our modern times.

WITH THIS ISSUE THE control of the Armour Engineer passes from the hands of the seniors to those of the juniors. It has been the custom for the May issue to be published with the newly elected editors acting in the executive positions. The seniors merely act in a supervisory capacity.

The Managing Board of the Engineer believes they have made a wise selection of men to fill the offices of Editor, Associate Editor, and Business Manager. The members of it—all seniors who will be graduated this coming June—think that the new executives will prove their merit. This issue stands as the first result of their endeavors.

KEEP A-GOIN'

If you strike a thorn or rose,
Keep a-goin'!
If it hails or if it snows,
Keep a-goin'!
'Taint no use to sit and' whine
When the fish ain't on your line;
Bait your hook an' keep a-tryin'—
Keep a-goin'!

When the weather kills your crop,
Keep a-goin'!
Though 'tis work to reach the top,
Keep a-goin'!
S'pose you're out o' ev'ry dime,
Gittin' broke ain't any crime;
Tell the world you're feelin' prime—
Keep a-goin'!

—Frank L. Stanton.

"THE ENGINEER'S OPportunities," as recently discussed at Armour Institute by Mr. Roy V. Wright, president of the American Society of Mechanical Engineers, is a subject of profound importance to the student of engineering. If the true spirit of engineering is appreciated, it is seen that the engineering profession is not only an excellent preparation for other vocations but is an exceedingly broad and important profession in which men are engaged in the practical work of contributing worthy services to an industrial civilization. The essence of technological training is the technique of approaching and solving problems with analytical skill. The supplementing of this academic proficiency with the practical solution of concrete problems in the face of many obstacles provides the elements of a good engineer and a constructive leader in industrial engineering. However, in view of the complexity of modern industry, it is necessary for the successful engineer to consider also the administrative functions and the organization and co-ordination of the various elements which comprise a successful and well-balanced engineering structure. Thus the administrative or executive engineer is well prepared for the problems of contemporary life and has the ability to create and enjoy true culture.

THE WORLD - WIDE INdustrial depression from which we are just emerging has wrought untold hardship and privation. The effects of the present economic disturbance have been most unfortunate.

Out from the depths of despondency, though, has arisen a new attitude,—a novel viewpoint which may, in the future, exert strong influence for the prevention of unbalanced conditions. We refer to the efforts toward business stabilization. With hitherto unknown intensity, study of the factors influencing trade conditions has been undertaken by various groups and organizations. Their findings are being discussed and weighed by men in business everywhere and a refreshingly new concept of matters is gradually taking form.

To the engineer the problem is one of primary interest. The American Engineering Council at its annual meeting held early this year considered plans for business stabilization, with the result that seven recommendations were made. These follow:

(1) Maintaining or increasing the consumption of goods and services; (2) balancing plant, machinery, and processes against production demands; (3) balancing distribution agencies against consumer requirements; (4) balancing man power against production and distribution demands; (5) controlling money and credit to satisfy the needs of government, business, and the individual; (6) encouraging research activity to increase human well-being through development and progress in industry and business; and (7) balancing public works against public need.

The efficacy of recommendations as a means to an end is of course questionable. However, proper realization of the elements involved makes the solution of any problem far less difficult than it might otherwise be.

COLLEGE NOTES

W. S. E.

A talk on the "Aesthetics of Bridge Design" was given February 27th, before the Armour Branch of the Western Society of Engineers by Professor M. B. Wells. Many valuable suggestions as to methods of beautifying bridge structures were pointed out for the competitors in the nation-wide bridge design contest sponsored by the American Institute of Steel Construction. Slides and projections from book illustrations were used extensively to show the unnecessary clumsiness and lack of pleasing lines in structures put up during the early days of this country.

Two Armour students in the department, E. Johnson and C. J. Robin, were among the ten men selected to compete in the final competition of the American Institute of Steel Construction bridge design contest. The competing problem was the design of a bridge and substructure for a seventeen hundred foot crossing over a navigable stream. The entire senior civil class entered the preliminary competition under the guidance of Professor H. T. Heald. The preliminary judgment was held in New York on April 1st, and telegrams announcing the awards were received by men April 6th.

Robin and Johnson submitted their final designs the 28th of April. First prize consists of a five hundred dollar award.

Johnson's solution is a two span arched crossing, and Robin utilized a braced cantilever construction.

A. I. E. E.

At a meeting of the Armour branch of the American Institute of Electrical Engineers, February 20th, Mr. W. Tierney, representing the Rockbestos Company of New Haven, Connecticut, spoke on "Asbestos Covered Cables." According to Mr. Tierney, cable insulation made of asbestos is a comparatively new product, since it is now only in its tenth year of practical use.

Two student talks were given at the regular meeting of the A. I. E. E., which was held March 13th. The talks were preceded by a short business meeting in which plans for a smoker were discussed.

"The Life of Michael Faraday" was the subject of the first talk by Thomas A. McGill, E.E., '32. Faraday, who was the most prominent physicist of the nineteenth century was honored by ninety-five scientific societies and universities. A wealth of information is contained in three huge volumes of electrical experiments which he performed.

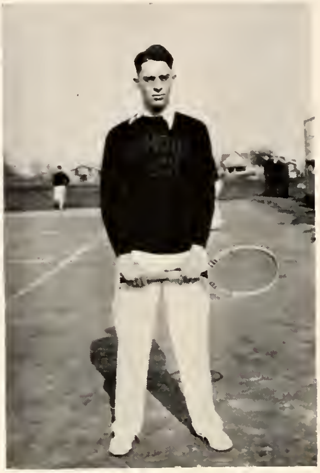
Max J. Schinke, E.E. '32, gave the second talk on "The Life of Joseph Henry." The problem of transmitting telegraph messages over long distances was first successfully solved by Henry. He was the first secretary and executive of the Smithsonian Institute.

Our Varsity Captains

Tennis

Richard R. Eddy, '31

Richard R. Eddy, captain of the tennis team, seems to have had close acquaintance with a tennis racquet for most of his years. As a sophomore at Proviso Township high school, his ability first began to assert itself in his record on the squad. He was elected captain of the team in his junior year and re-elected the following season. With a long string of victories behind him, he entered the University of Chicago Interscholastic Tournament, emerging with an excellent showing up to the quarter finals.



Richard R. Eddy

In the fall of 1927, Eddy entered Armour in the department of Fire Protection engineering and once again his tennis activities were resumed. For the past three years he has been a member of the squad, earning two letters. This year, with a tough schedule confronting the team, Eddy predicts a highly successful season.

In addition to the athletic activities, Dick is prominent in school affairs. He is conductor of the orchestra, a member of the Honor A Society, president of Pi Nu Epsilon, and a member of the Senior Social Committee. Sigma Kappa Delta claims him.

A. R. A.

Changes in the operation of the Armour radio station were made at a meeting of the Armour Radio Association Friday, February 27th.

The radio transmitting station, now in working order, will be employed to maintain regular schedules with similar units in other colleges and universities.

A. I. Ch. E.

At a meeting of the Armour Branch of the American Institute of Chemical Engineers held April 22nd, three reels of film illustrating the processes of manufacture of nitro-cellulose were shown.

The films were supplied through the courtesy of the Brevolite Lacquer Company of North Chicago, Illinois. At the close of the film, Paul Mayfield, of the Hercules Powder Company of Wilmington, Delaware, gave a short address to the student and faculty members.

A. S. M. E.

Professor G. F. Gebhardt, head of the department of mechanical engineering, delivered a talk on "The Effect of Fineness on Boiler Efficiency," before the National Fuels meeting of the American Society of Mechanical Engineers, February 12th. This meeting was held in conjunction with the Fifth Midwest Power Engineering Conference which was held at the Stevens Hotel.

Three reels of a motion picture entitled "Steam" were shown to the members of the A. S. M. E. March 13th. The pictures were explained by Mr. Ripley of the Babcock and Wilcox Company.

The motion picture was followed by slides, showing several different types of boilers, and then explaining the manufacture of high pressure seamless drums. It requires four days to beat the huge blocks of iron to the desired temperature. Then under terrific pressures, the iron is gradually shaped into the proper form, the entire operation requiring nine to ten weeks.

F. P. E. S.

Mr. R. E. Vernor described the work and organization of the fire prevention associations to the Fire Protects at a meeting of the F. P. E. S. held February 27th.

According to Mr. Vernor, the whole country is now vitally interested in preventing fires and everywhere efforts are being extended to reduce the loss per capita.

Some very interesting pictures of scenes of fires were passed around at the close of the meeting.

Mr. George Stahl of the Engineering Department of the Chicago Board of Underwriters spoke at the F. P. E. S. meeting Friday, March 27th, about the Chicago Fire Department.

The Chicago Fire Department is under the Executive Branch of the Municipal Government. The fire department was organized on a paid basis in 1858. The captains were paid $200 a year and the lieutenants received $100 for the same period. It was not until 1920 that the last horse drawn wagon was replaced by a motor powered engine, and the department became completely motorized.

Tennis Team Begins Season With Defeat

The merits of the tennis squad have not as yet been determined. The first match was played during the latter part of April with all the men in rather bad condition, due to lack of practice. These spring rains and cold spells have certainly played havoc with the boys, as they were kept under cover most of the time awaiting a warm southern breeze and a ray of sunshine. When conditions permitted, which was seldom, the boys were out with spirit to get in trim and develop some of those well directed wallops.

Captain Eddy and Schirmer are rated as the number one and two men. They are playing combination double and single matches. Streb and Cone compose the second combination. These last two have shown some very promising results and much is expected from them in the near future. Lind and Timmermans hold the other two positions on the present squad.

In their first match the squad met defeat at the hands of Valparaiso. The second game, which was scheduled with "Y" College, was called off because of rain. The rest of the schedule is beyond a doubt considered a tough one, with Notre Dame, Loyola, and Lake Forest on the list. The schedule is as follows:

At Valparaiso—April 27.
At Y. M. C. A.—May 6.
At Lake Forest—May 9.
At Notre Dame—May 12.
At Armour with Loyola—May 15.
At Armour with Valpraiso — May 20.
At Loyola—May 23.
At Armour with Lake Forest — May 27.
At Armour with Y. M. C. A.—May 29.

Baseball Team 1931

Reading left to right, back row: Somers, Lynch, O'Connor, Stehno, Buehne, Krafft, Schohl. Middle row: Cannell, Omiecinski, Robin, Michalski, Mago, Moskowitz. Front row: DeOrio, Pepe, Young, Reed, Galvani.

Golf Team in Midst of Tough Schedule

The 1931 golf team is rather fortunate in having four of last year's regulars back in active competition. Captain Weis, Pearson, Johannisson, and Alexander have returned to form the nucleus of the present squad.

A school tournament was held on Saturday, April 11th for the purpose of trying out any new men. The tournament consisted of eighteen holes of medal play, the low scorers afterward playing eighteen holes of match play. The winner, Fred Ollison, Jr., together with two other low scorers, Wyant and Weldon, qualified for positions on the golf squad.

Baseball Team Off to a Good Start

From the present outlook of things it seems that the Armour nine is on another grand tour of the baseball schedule. This means that it will be the sixth consecutive season of success. Early predictions seemed to place the present squad in a hopeless position because of the losing of a string of men and that great "old faithful," King Simpson.

In the infield, Coach Krafft has successfully developed two freshmen, namely Moskowitz and Omiecinski, to fill in at the short stop and second base positions. The veterans Mago and Captain Robin cover their respective positions of third and first base. Lynch, another freshman, has stepped into the hurling department with "old iron sides" Stehno and has contributed some wonderful pitching, thereby fulfilling the hope of finding a good hurler among the recruits. Young has aided in the catching along with the veteran Charley Link, while Pepe, Somers, and Michalski have held down the outfield positions. Both Somers and Michalski are playing their first seasons with the team.

With over half the games on the schedule already having been played, the squad has a string of victories over Crane, Lake Forest, Morton, Wheaton, and two over North Central. The Western State Normal game was the first set-back of the season. Those Hilltoppers have always produced a strong team; in fact, one that has continuously been giving the strongest kind of competition to the Big Ten nines.

Looking down the list of Tech's batting averages so far this year, we find that Captain Robin, Moskowitz, Omiecinski, and Stehno are all holding their own in good fashion. Omiecinski and Robin have been doing some wonderful home run slugging.

Swimming Team Finishes Its Season

Although confronted with the task of competing with five of the best swimming teams ever placed on its schedule, Armour's swimming team closed its 1931 season with two wins and one tie against two defeats. Victories were obtained in the meets with Illinois Wesleyan and Loyola, while Crane College and Culver Military Academy handed Armour the losses. The tie was established in the meet with Hyde Park Y. M. C. A.

The meet with Illinois Wesleyan College resulted in a 48-27 triumph, while Loyola succumbed 38-37 in the last meet of the season. After getting away with a good start by winning the 160 yard relay and 220 yard free style, Armour rapidly lost ground in the succeeding events and was forced to acknowledge a 40-33 defeat from Crane College. Culver's 43-23 triumph over Armour was the most decisive defeat Armour received in two seasons.

Captain Knox, having been a champion swimmer long before he came to Armour, was in position to be of special help to his teammates. As anchor man of the 160-yard relay team, Knox was highly responsible for the four victories that the relay quartet garnered.

Andy Weston, scoring 43 points, was high point man for the season. He competed in the 220-yard free style and the 100-yard backstroke events. Being the only regular backstroke man on the team, he was in a position to make points in almost all the meets.

Jack Cavanagh and Eddie Byanskas also figured as important cogs in the tank team. Jack had his own way of coming through with a first or close second in many of the breast stroke events. He shows promise of being a consistant point getter next year. The relay team found Eddie Byanskas a great help, for his steady work enabled Armour to improve their swimming record.

Another member of the record relay team was Carlstrom. He confined his attention to this event most of the time but often took part in the 100-yard free style. Giovan, mate of Carlstrom in the crawl relay, concentrated on this event during the greater part of the season.

Notwithstanding the fact that Thomson was sick during two meets, he piled up a number of points. His fancy diving was of a unique character, correct, and graceful.

Tau Beta Pi

Tau Beta Pi, honorary engineering fraternity, at a meeting held at the Sigma Kappa Delta House Thursday, March 26th pledged the following men: A. Bogot, M.E., '32; C. N. Cannon, M.E., '32; E. H. Chun, M.E.,'32; H. R. Davis, M.E., '32; M. Fagen, E.E., '32; R. E. Meagher, C.E., '32; H. C. Rossing, C.E., '32 W. H. Rudolf, C.E., '32; E. A. Scanlan, Jr., F.P.E., '32; W. M. Trauten, F.P.E., '32.

Alvin B. Auerbach, a senior in the department of civil engineering, was awarded the Tau Beta Pi fellowship for the coming school year. He will continue his studies at the University of Illinois Graduate School at Champaign beginning next fall.

Salamander

Salamander, honorary fire protection engineering society, held its initiation at the Theta Xi House on April 1st. E. A. Scanlan, Jr. and G. W. Schodde were the two men initiated. Professor Holmes, J. V. Parker, Fitzhugh Taylor, W. R. Townley, R. M. Beckwith, R. O. Matson, and C. J. Hanth were among the older members present.

The Annual Banquet of the Society was held on April 8th in the Green Room of the Hotel Knickerbocker. There were fifteen men present with Professor O. F. Robinson acting as toastmaster.

Phi Lambda Upsilon

Three new initiates are announced by the honorary chemical fraternity, Phi Lambda Upsilon. They are:

Stanley M. Lind.

Orville G. Linnell.

Ralph H. McCormack.

Pi Tau Sigma

The honorary mechanical engineering fraternity, Pi Tau Sigma, has initiated five men of the Junior class:

A. Bogot.

E. H. Chun.

A. J. Jungels.

R. F. Waindle.

Boxing

After getting started on a remarkable winning spree, Armour Tech boxers reluctantly laid aside their paraphernalia and, because of the official close of the season, postponed action until next year. With only three letter men back from last year's squad, Coach Weisman found it necessary to rebuild practically an entirely new team. The three veterans were Capt. Ustryski, Montesano, and Sandstrom. Injuries also exacted a considerable toll in the Tech camp and greatly jeopardized the showing of some of the men. From an individual standpoint the showings were very commendable. An abundance of middleweights graced the squad. Incidentally, most of the fights won by the Tech pugs featured plenty of glove throwing. Straying from the conventional method of teaching the fighters merely the scientific phase of the game, Coach Weisman, realizing that most decisions favor the heavy puncher, drilled his men in the rudiments and then permitted them to develop their punching power, which manifested itself in the double trouncing given Loyola University.

Great things are expected from the 1932 squad as the aggregation will be practically intact with the exception of Montesano and Mago, who will graduate.

Tentative meets have been arranged with St. Viator College, Valparaiso University, Loyola University, Culver Military Academy and perhaps some local clubs. These meets will be home and home encounters, affording Armour enthusiasts an opportunity to see the squad in action at least three times.

The following boxers will receive letters; Capt. Ustryski, Montesano, Campioni, Rush, Sandstrom, Mago, Heckmiller, while Melevsky, Hoffberg, Bacci and Kosan will receive sweaters for their efforts. Manager Cannon will be awarded a manager's letter.

Eta Kappa Nu

Eta Kappa Nu, honorary electrical engineering fraternity, has conducted an essay contest open to sophomore electricals. Either a copy of the Standard Handbook for Electrical Engineers or its equivalent will be given to the author of the winning essay. The essays were given to Professor Richardson on April 1st. They will be merited on subject matter, quality of presentation, and form. The judges were:

R. Patzelt, '31; W. Drigot, '31; W. E. Penfold, '31; T. B. O'Connor, '31; M. Fagen, '32.

The following men were initiated into Eta Kappa Nu on Friday, April 24th:

Emerson G. Squires, '31; George L. Bonvallet, '32; Thomas A. McGill, '32; Virgil J. Minnick, '32; Max J. Schinke, '32.

Sphinx

Thirteen men who have done outstanding work on the Armour publications have been pledged to Sphinx, honorary literary fraternity. Their names follow:

M. R. Beal, F. P. E.
E. W. Carlton, E. E.
J. J. Casey, C. E.
F. D. Chapman, Arch.
H. R. Davis, M. E.
M. Fagen, E. E.
J. R. Jackson, Jr., F. P. E.
C. J. Jens, F. P. E.
J. S. McCall, M. E.
H. P. Richter, C. E.
W. H. Rudolf, C. E.
M. J. Schinke, E. E.
G. W. Schodde, F. P. E.

The pledging ceremonies were held at the Phi Kappa Sigma House, Thursday evening, April 23rd.

Pi Nu Epsilon

Pi Nu Epsilon, honorary musical fraternity, held a smoker on Thursday, April 16th for its future pledges. The pledging ceremony took place Thursday, April 23rd in the Tau Beta Pi rooms. The pledges are:

L. J. Ferguson, Ch.E., 31; E. W. Carlton, E.E., '32; W. H. Hornberger, C.E., '32; T. A. McGill, E.E., '32; J. E. Walker, M.E., '32; A. H. Weston, E.E., '32.

Dr. Howard Raymond was pledged as an honorary member of Pi Nu Epsilon.

Chi Epsilon

Chi Epsilon, honorary civil engineering fraternity, takes pleasure in announcing the initiation of the following men:

Carl A. Erickson, '32.
Oscar Eskonen, '32.
Albert A. Koch, '32.
Harvey C. Rossing, '32.
Wilbur H. Rudolf, '32.

Scarab

Scarab, honorary architectural fraternity, takes pride in announcing the results of the recent competition sponsored by the American Steel and Bridge Co. Of the three winners, two were alumni of Edfou Temple of Scarab. Eugene Voita, instructor of architectural design in Night School, winner of first prize, was awarded two thousand dollars for his design and Howard Vader, who is connected with Holabird and Root, was the recipient of five hundred dollars in recognition of third prize.

Concentrated efforts on the part of the alumni as well as the actives has increased the attendance of the regular bi-monthly luncheons.

The Armour Alumnus

Volume VI May, 1931 Number 4

School Mourns Loss of Palmer

Sudden Heart Attack Brings About Death of Dean and Professor of Mathematics

When Dean Claude Irwin Palmer passed away on Thursday morning, April 9th, Armour Institute lost a man who was deeply revered by alumni, undergraduates, and the faculty. Professor Palmer was a man who literally gave his all to the task of teaching and advising students of Armour. For example, during the last few days of his earthly existence, Dean Palmer insisted on being at the Institute to conduct classes and supervise work in the offices of the Dean, even though his physical condition was delicate. All who knew our congenial Dean had the greatest regard for him as an earnest worker who would go to extremes for any cause he considered worthy of his efforts.

It had been known for some time that Dean Palmer was in poor health, and his faculty associates often urged him to take an extended vacation. In fact, several professors were in his company when he was stricken with a severe heart attack at the University Club only a month before the final stroke. The strong sense of responsibility was foremost in Professor Palmer's mind, however, and he felt that his absence from Armour would mean the neglect of an important duty.

Finally, he consented to see a physician. As he was driving from the doctor's office, Dean Palmer sensed an oncoming attack, stopped the car and collapsed as he was stepping out onto the running board. He was pronounced dead by Dr. Stewart.

The molding of Professor Palmer's character and personality was a most colorful and interesting one, for the story of his life reveals that everything he accomplished was done by hard work, with no small amount of mental anguish. Dean Palmer was born of old Yankee stock on May 31, 1871, near Battle Creek, Michigan. His early boyhood was spent on a farm near Lake View, in Montcalm County.

Youth for Dean Palmer included many adversities to the pursuit of an education. He was thrown into unfortunate circumstances by the death of his mother when he was but thirteen years of age, and his subsequent life was deeply affected. As a boy, his chores were those of any farmer lad. He was fond of such a life but there was still a greater desire within him.

The art of teaching attracted him early in life and he began to instruct in district schools when but nineteen years of age. Intermittently, he attended Normal College when his savings would meet the incident expenses. Dean Palmer finally entered the University of Michigan and realized a youthful ambition when the degree of Bachelor of Arts was conferred upon him in 1903. Immediately after graduation, he joined the faculty at Armour. His genius in mathematics was soon recognized and in 1910 he received the title of Associate Professor of mathematics. When Dr. Campbell and Dean Monin retired in 1927, he was made Professor and Head of the Department of Mathematics and Dean of Students.

Claude Irwin Palmer

Since the first textbook published by Dean Palmer, "Practical Mathematics," he has written or collaborated in the preparation of eleven books on mathematics, most of which are widely used in American colleges. More than half a million copies bearing Professor Palmer's name have been sold—an indication of his influence upon the training of engineers.

Professor Palmer was a member of the American Mathematical Society, the Mathematical Association of America, the American Society for the Advancement of Science, and the Society for the Promotion of Engineering Education. He was affiliated with the University Club, the Midway Athletic Club, and the National Arts Club of New York. Dean Palmer was an elder in the First Presbyterian Church of Chicago.

Dean Palmer is survived by his wife, a son Clarke, who is attending the University of Illinois, and a daughter, Mrs. Henry Swanson, of Oak Park, Illinois.

Professors Wilcox, Roesch, Libby, Swineford, Krathwohl, and Mr. Kelly acted as pall-bearers at Dean Palmer's funeral. The services were held at the First Presbyterian Church, with interment at Oakland Cemetery.

A. H. Everly Passes Away in March

Arthur Harlan Everly, E.E. '28, passed away Wednesday, March 18th in Bushnell, Ill., at the home of his parents. While attending the Institute, he was active, being a member of Eta Kappa Nu, the Glee Club, and the varsity track team. After graduation, he worked with the General Electric Co. In June of that year he married Miss Neva Crabtree. The following month Everly was transferred to the Schenectady plant of the General Electric, at which city he lived. A year later he returned to Chicago, where he was employed by the Illinois Bell Telephone Co. until his death.

Wilbert B. Deiring, M.E., '22, is with the Berlin Chapman Company, Berlin, Wisconsin. Deiring is employed to design machinery.

James A. Davidson, F.P.E., '26, is doing fire insurance work for the Western Factory Insurance Association. Davidson is living in Dayton, Ohio, at 2200 Far Hills Avenue.

George A. Crapple, Ch.E., '28, is keeping step with his chosen profession while in the employ of Adolf Gabel and Company, New York City.

Jeff Corydon, M.E., '22, is the Chicago representative for the company of Max B. Miller, Inc., of New York.

Robert D. Courtney, C.E., '30, is a Junior Engineer in the employ of the United States Geological Survey.

Everett A. Cooper, F.P.E., '26, has become associated with the J. B. Henderson Insurance Agency, located in Alhambra, California.

William R. Collins, Ch.E., '06, is District Manager for the Anaconda Wire and Cable Company, with offices located at 20 N. Wacker Drive, Chicago, Illinois.

PERSONALS

Walter J. Ehrmeyer, E.E., '29, is a Junior Engineer with the Commonwealth Edison Company.

Joseph L. Duffy, C.E., '15, holds a responsible position as Engineer in the International Harvester Company plants, located in Chicago.

Peter J. Duerinck, EE., '23, is an Assistant Engineer with the Public Service Company of Northern Illinois.

W. E. Downes, C.E., '26, and one of the active alumni athletes, is an Engineer in the Department of Local Improvements of the City of Chicago.

Robert D. Doubt, E.E., '28, formerly employed by Armour and Company, is now an Engineer in the service of the American Can Company.

James J. Doheny, Ch.E., '27, is an instructor at St. Mels High School, Chicago.

Cyril C. Fraser, M.E., '27, is now general manager of the McGann Manufacturing Company of York, Pennsylvania.

Herbert Sprecher Grenoble, M.E., '10, formerly Industrial Specialist in the Forest Products Laboratory, of Madison, is now doing special work al Virginia Polytechnic Institute.

Joseph C. Hromada, E.E., '29, holds a government position in the Bureau of Lighthouses. Hromoda is in the Engineering Airways' Department, with offices located in Washington, D. C.

R. E. Escott, E.E., '30, is employed as a student engineer with the Illinois Bell Telephone Company.

Terrell J. Ferrenz, C.E., '11, is Supervising Architect of the organization headed by Frank D. Chase.

Robert G., C.E., '10, and Arthur G., Eliel, Arch., '14, are successful architects in Rockford, Illinois. These two brothers have their offices located at 813 N. Main Street, Rockford, Illinois.

Ralph Hilliard Earle, E.E., '17, formerly with Allis Chalmers Co., is now an engineer with the Line Material Company, South Milwaukee, Wisconsin.

J. M. Eckert, C.E., '10, is President and Treasurer of a company bearing his name.

Voita and Vader Win Prizes for Water Tower Design

Eugene Voita, Arch., '25, has been announced the winner of the first prize in the contest sponsored by the Chicago Bridge and Iron Works. The problem was the design of an aesthetic water tower, and about 500 American and 200 European architects were entered in the competition. The first prize was an award of $2000. Voita is a night school instructor at the Art Institute and a day school teacher at the Burnham Public School.

Howard W. Vader, Arch., '16, carried away third prize in the same contest in which Voita carried away first honors. The cash award for the third place was $500. Vader is an architect for Holabird and Root, a Chicago firm.

SOLITUDE

Laugh, and the world laughs with you;
Weep, and you weep alone.
For the sad old earth must borrow its mirth,
But has trouble enough of its own.
Sing, and the hills will answer;
Sigh, it is lost on the air.
The echoes bound to a joyful sound,
But shrink from voicing care.

Feast, and your halls are crowded;
Fast, and the world goes by.
Succeed and give, and it helps you live,
But no man can help you die.

There is room in the halls of pleasure
For a long and lordly train,
But one by one we must all file on
Through the narrow aisles of pain.

—*Ella Wheeler Wilcox*

Whitfield to Get Ch. E. Degree at Columbia

Marshall Whitfield, Ch.E. '30 will be among the few to receive the degree of Chemical Engineer at Columbia University this June. The normal time for receiving this honor is three years. Last year Whitfield was awarded a fellowship to that university. By accomplishing his task in only one year, Whitfield has done something of which very few are capable.

Joseph F. Lucas, M.E. '23 is connected with the Hartford Fire Insurance Co.

Charles E. Morris, Ch.E., '30 is connected with Armour and Company. He is employed in the research department.

PERSONALS

Harry Krieger, F.P.E. '28, is located at Columbus, Ohio, where he is working for the Inspection Bureau of the State.

John T. Lucas, C.E. '13, is employed by the Board of Education in Chicago as a construction engineer.

John R. Yount, Ch.E. '29, is connected with the Bakelite Corporation. Incidentally, Yount has a brother attending Armour in the department of fire protection engineering.

Our well known George Jennings has recently achieved the honor of winning the Western Indoor Tennis Championship. He accomplished this by defeating last year's champion, Larry Tieman, and A. McAllen, former Ohio State champion. The meet was held in Cincinnati.

Alfred Edwards, Ch.E., '21, is a member of the sales corps of the United States Gypsum Company. His home is in Kenmore, New York.

Arthur T. Martin, Ch.E., '30 is now employed by the Victor Chemical Company.

C. I. Carlson, M.E., '30, has only recently recovered from an attack of scarlet fever at his home in Aurora, Illinois. Mr. Carlson is a teacher of mechanical drawing in the Aurora High Schools.

Richard Logan, F.P.E., '28 is now employed with the Kentucky Inspection Bureau at Louisville.

John Attwood, Ch.E., '29 is now working for the Battelle Memorial Institute at Columbus, Ohio.

D. C. Baldwin, F.P.E., '30, who is now employed by the Iowa Inspection Bureau is to be married on May 30.

J. E. Tarman, Ch.E., '30, is now employed in the research department of Armour and Company.

Irving Lueth, E.E., '28, has been working with the International Telegraph and Telephone Company since his graduation.

R. C. Peacock, x-'27, has recently returned to Africa. He is stationed this time on the west coast of Africa being employed by the U. S. government. It will be remembered that an article written by Peacock on Liberia was published in the January issue of the Engineer.

PHILLIP'S DEATH BLOW TO CIVILS

Friends and associates were indeed grieved to learn of the death of Professor Alfred Edward Phillips, head of the department of civil engineering, on Sunday, April 19th. Professor Phillips had been suffering from a complication of diseases, being confined in the Presbyterian Hospital for five weeks just prior to his death.

Professor Phillips had come to be a recognized force in the growth of Armour since his relationship with the Institute which began in 1899. To this man, almost singularly can the credit be given for the establishment of the splendid curriculum in civil engineering, which now exists at Armour Institute.

As the sad news of his death spread throughout the school, many groups of students, especially those who have had occasion to study under him, were heard discussing and mourning the sudden loss of their professor, counselor, and friend. "Pa" Phillips, as he had become commonly known to his students, was probably one of the most popular professors in the Institute. This was due undoubtedly to his unstinting efforts in behalf of his students, even at a time when his health was fast failing. Professor Phillips had always appreciated the name "Pa" because of the feeling embodied in it and because of the atmosphere of friendliness and informality it brought about.

The civil engineering department keenly felt his passing as a personal loss. The stability, nonchalance, and the dry humor which characterized this man makes his memory a cherished one.

Professor Phillips was born on June 18, 1863, at Rouse's Point, New York. He was educated in a private school in Rouse's Point, and in the public schools of Champlain, N. Y., and La Colle, Quebec, Canada. He was tutored for college by a clergyman, who had been trained in engineering. In 1883, he entered Union College at Schenectady, New York.

He attended Union College for four years, during which time he became a member of the Phi Delta Theta Fraternity.

In his senior year he was elected to membership in the honorary scientific fraternity, Sigma Xi. He was graduated with the degree of A.B. and C.E. Union College likewise conferred upon him an A.M. degree in 1890 and a Ph.D. degree in 1894.

After graduation, Professor Phillips went to Tennessee and took a position with the Cumberland Valley and Unaka Railroad. The railroad was running a traverse across the Cumberland mountains from Knoxville, Tennessee, to the Atlantic Coast. In the fall of 1887, Professor Phillips went to Purdue University and established their department of civil engineering, remaining there as head of the department until 1894. During this time, he was also an assistant engineer of the New York State Board of Health.

From Purdue he went to the University of Wisconsin, where he served as a professor in bridge and hydraulic engineering. After a year there, he became engaged in private work throughout Illinois and Indiana, doing sewage disposal and water supply engineering work.

In 1899 Professor Phillips came to Armour Institute as professor of civil engineering, and since that time has been at the head of the department. While at Armour, Professor Phillips wrote numerous text books on such civil engineering subjects as roof trusses, irrigation, masonry construction, surveying, and highway construction.

Alfred Edward Phillips

Professor Phillips was very fond of the outdoor life, maintaining a summer home within walking distance of the summer camp of the freshmen civils along the shores of Trout Lake, Wisconsin. During his earlier days he was active in running the camp, but during his late years Professor Phillips satisfied himself with being an expert fisherman.

Professor Phillips' death is mourned by his wife and two daughters, as well as a host of friends.

Philip S. Deiwert, F.P.E., '28, was seen recently in the neighborhood of the Institute. He came back to renew some of his old acquaintances. Phil has been spending most of his time in Indianapolis in the employ of the Indiana Inspection Bureau.

Jack Dollenmaier, E.E. '30, is working for the State Public Service Commission at Springfield, Illinois. He is employed in the power division.

W. H. Hallstein President of Purchasing Agents Asso.

Walter H. Hallstein, C.E., '14, was recently elected president of the Purchasing Agents Association of Chicago. He has been the purchasing agent for the Ilg Electric Ventilating Company since 1917, at which time he became a member of the organization which he now heads.

In 1928 Mr. Hallstein was selected for the position of treasurer of the Ilg Company and he has held that office along with his purchasing agent work ever since that time.

Alumni Golfers Fall Before Varsity 8 to 7

On Saturday, April 18th, the alumni golfers met the varsity in their annual game. The alumni representatives were Al Joseph, '25, Charley Lang, '27, and Hank Christensen, '29. The varsity team was composed of Pearson, Johannisson, Weis, and Ollison.

The matches were hard fought as the close score of 8 to 7 indicates. The matches were as follows:

Pearson, varsity	2
Joseph, alumni	1
Lang, alumni	3
Johannisson, varsity	0
Christensen, alumni	2½
Weis, varsity	½
Christensen, alunmi	½
Best ball of Weis and Ollison	2½
Pearson and Johannisson	3
Joseph and Lang	0

Sidney I. Cole, M.E., '28, is Vice-President of the Lee Construction Company. His offices are located at 155 N. Clark Street, Chicago, Illinois.

A. B. Chapman, E.E., '10, is a Supervisor in the employ of the Michigan Bell Telephone Company, Detroit, Michigan.

Lester O. Castle, F.P.E., '27, is working in Milwaukee, Wisconsin, with the James S. Kemper Company.

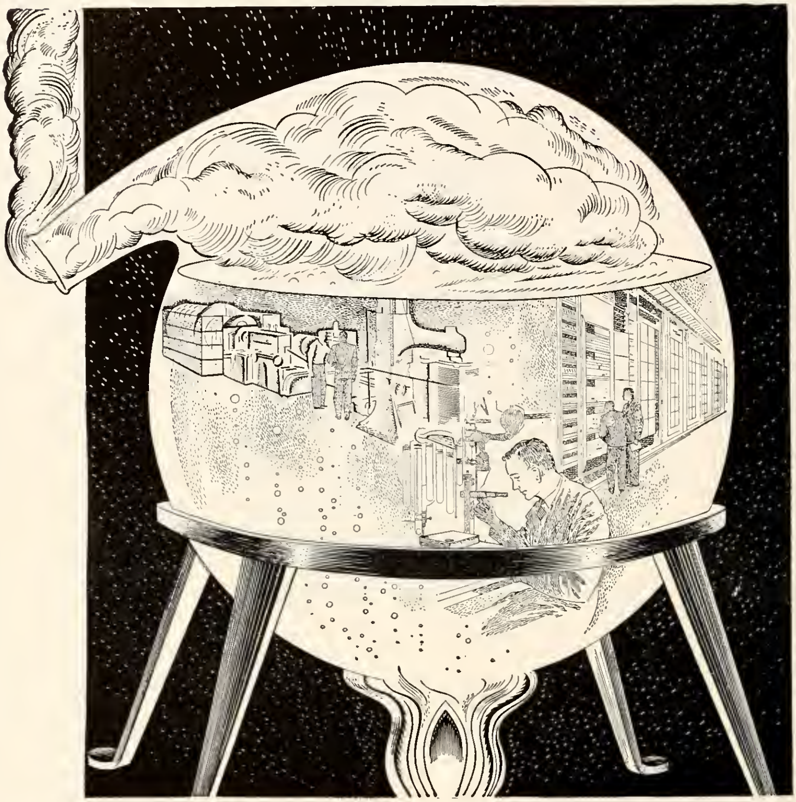
Earl Busch, Arch., '26, is a Sales Engineer for the American Skylight Company of Chicago. Busch makes his home at 57 Forest Avenue, Riverside, Illinois.

William D. Egan, Ch.E., '29, enjoys his work as Junior Chemist in the laboratories of the Peoples Gas Light and Coke Company, Chicago.

Curt W. Diemecke, Ch.E., '15, is District Representative for the L. J. Wing Manufacturing Company, Chicago, Illinois.

Elmer F. Dhus, Ch.E., '22, has a position with the Hammermill Paper Company, Erie, Pennsylvania.

STEPPING INTO A MODERN WORLD



"TEST IT"

The watchword of an industry

The Bell System — whose nation-wide plant cost more than $4,000,000,000 and is still growing—makes use of nearly every type of engineering.

Here there is insistent demand for new ideas that will stand the test, not only in telephone apparatus development but also in manufacture, construction, installation, maintenance and operation.

To carry on these activities, problems in each branch of engineering—electrical, mechanical, civil, industrial, chemical—must be solved. Even more important, "telephone engineering" calls for the broad engineering point of view as well as specialization.

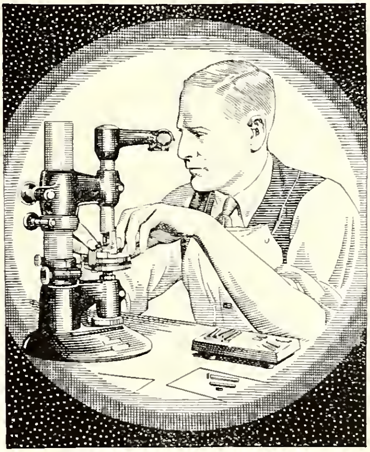
Basic technical knowledge, an appreciation of economic factors and the ability to cooperate are some of things that count in Bell System engineering.

"NEAR ENOUGH" does not satisfy WESTERN ELECTRIC

To Western Electric engineers, a piece of telephone apparatus that is not exactly right is all wrong.

Where precision is a prime requisite there is no compromise. For such work, machines are designed that are marvels of manufacturing accuracy, turning out millions of tiny parts that do not vary from standard by a fraction of a hair. Tests are devised which in a few hours subject parts to wear and tear equalling that of years in service. Nothing can be left to chance!

There is more, though, to Western Electric's work than insistence on exactness, important as that may be. Smooth functioning of inter-related departments, proper utilization of vast facilities, imaginative approaches to new tasks as well as old — these too are essential in serving the Bell System as its manufacturer.



Carrying out Western Electric engineers' insistence on accuracy, this master craftsman can work within limits of .00001 of an inch—one-three-hundredth of the thickness of a hair!

BELL SYSTEM

A NATION-WIDE SYSTEM OF INTER-CONNECTING TELEPHONES

UNBALANCED MOMENTS

EVIDENCE

Meek: "I never spoke a cross word to my wife but once."
Meeker: "Quite remarkable, that."
Meek: "Not so very; see that scar?"

Conductor: "Watch your step, Miss."
Miss: "It's not necessary; there are several saps doing that already."

There's a story going around about the Scotchman who wanted to smoke monogrammed cigarettes, so he changed his name to Chesterfield.

Then there was the Scotchman who told his children that Santa Claus was going to drive an Austin this year.

Frosh: "Gee, look at the wrinkles in that co-ed's neck."
Soph: "Wrinkles, your aunt, them's service stripes."

Ticket Agent: "This ticket costs $50 and allows you a three day hangover in Detroit."
Buyer: "And how much if I don't get drunk?"

Old Lady (to street car motorman): "Please, Mr. Motorman, will I get a shock if I step on the track?"
Motorman: "Not unless you put your other foot on that wire up there."

"I am going to shoot the guy that married my wife."
"But that's murder."
"No, it's suicide."

A SAD CASE

News Item: A parlor maid went crazy the other day in a round house. She was looking for a corner into which to sweep the dust.

Barber: "And how do you want your hair cut, girlie?"
Girlie: "With a hole in the top like papa's."

Cafeteria: A place where men learn to think on their feet.

"What is a slide rule?"
"Never slide with your NEW pants on."

"No use crying over spilt milk," soliloquized the unromantic farmer as the express train severed the torso of his favorite cow.

Helen: "You say your fiańce was killed in a blind-fold test?"
Grace: "Yes, he faced a firing squad."

TOE DANCER?

Alice: "Gee! Some dance."
Dick: "Yeah—and some don't."

"Say Jack, you want to keep your eyes open today."
"Why?"
"Because people think you are foolish if you go around with them closed."

THE CAREFUL STUDENT OF AERONAUTICS RIDES AN UPPER

CALL THE DOCTOR

Blonde Waitress: "I have stewed kidneys, boiled tongue, fried liver, and pigs feet."
Diner: "Don't tell me your trouble, sister; give me a chicken pie."

Senior Civil: "What's that bump on the front of your car?"
Another Wreck: "Oh, the radiator just had a boil."

Junior: "I couldn't get Problem 8, Professor; it's too hard."
Professor: "Yes I know, it's that dam problem."

Spinster: "Do you know what happens to little boys who draw pictures on the sidewalk?"
Boy: "Yes they go to college and take architecture."

E. E.: "What makes you think my head is made of cork?"
C. E. "It's always at the neck of a bottle."

LIVE WIRES

Frosh: "Why is there so much electricity in my hair?"
Soph: "Because it's connected to a dry cell."

Efficiency Expert: One who dips flies in luminous paint so that you can swat them at night.

Salesman: "I wonder if I can see your mother. Is she engaged?"
Sunny Boy: "Engaged! Man, she's married."

A genius is a man that can sell a travelling man's story to the Ladies' Home Journal.

F. P. E. in lunch room after waiting hours for service:
"Hey! How about a date with a couple of hard boiled eggs?"
Waitress: "Sorry, but I have to work until ten-thirty."

Hometowner: "Where have you been these last four years?"
College Student: "At school taking medicine."
Hometowner: "Did you finally get well?"

"What does a man have to be in order to be buried with military honors?"
"Why, he must be a captain."
"Shucks, I lost my bet that he must be dead."

A bunch of jokes I just sent into a magazine were rejected as no good, but when I threw them in the fire it simply roared.

A NOSEY STORY

First Child: "We have a goat at our house, but he doesn't have a nose."
Second Child: "How does he smell?"
First Child: "Something terrible."

Prof. (in business law class): "Schueler, what is the international law on straights?"
Schueler: "A straight flush beats three of a kind."

"What a whale of a difference a few scents make," cried the ad-writer as he tumbled over the skunk.

"Father, what's a pedestrian?"
"A pedestrian, my boy, is a college man's father."

"That's enough out of you," snapped the doctor as he stitched the patient together again.

Engineering News

(Continued from page 125)

other hand, in the case of the accurately ground cylinders, this risk is eliminated and the cylinders are capable of taking the load immediately without the slightest chance of danger from seizure.

Engine Vibration and Passenger Comfort

The problem of producing an aircraft engine as free from vibration as the present day automobile engine is very difficult as the designer cannot use mass to absorb vibration by static inertia. From the standpoint of durability the terminal, lubricating, and metallurgical problems involved are much more important than the reduction of external vibration, and the burden falls upon the designer to build a structure around the engine which will absorb the vibration without causing discomfort to pilot and passengers. Certain types are inherently more or less free from vibration, but others must be mechanically balanced. Even with such precautions in the best modern designs, objectionable external vibration always exists, due to the low weight-power ratio.

Vibratory energy from the engine must be absorbed by the static inertia of the airplane. This may be accomplished by increasing either the weight or the rigidity of the structure, but, as the weight must be kept to a minimum, the greatest possible stiffness must be obtained by so distributing the material that the maximum moment of inertia will be obtained about the principal axes of vibratory movement. By suitably proportioning the structure, the lower vibrational frequencies are readily absorbed, but recourse must be had to cushioning pads built into the engine-mount to reduce the effect of higher frequencies. The function of such pads is to transform the high frequencies into those of a lower period which may then be absorbed by the structure. Where engine and framework are rigidly joined together the vibrations originating in the former are transmitted directly to the latter. Such forced vibrations in the structure are frequently in phase with those of the engine and the net result is a vibration of increased amplitude at the original frequency. If the structure is permitted to vibrate at its own natural frequencies without being forced into synchronism with the engine through a direct connection, the natural frequencies of the two will probably be widely separated, and their mutual interference will result in some intermediate frequency of reduced amplitude. Cushioning pads in engine mounts will materially reduce the period of vibration in the body structure and will also reduce the amplitude in proportion to the internal friction developed in the pad.

The material used in these pads is rubber in some form. The danger from the use of pure rubber is too much, rather than too little flexibility. This may be reduced by the actual size of the pads, though a better material is rubberized fabric, in which layers of cotton fabric are alternated with layers of rubber. This type of pad has a large capacity for consuming energy due to greater internal friction, and it has greater shock resistance with small deflection, as the rubber is divided into thin layers and the flow is uniformly restricted. The actual composition, size, and treatment of the rubber itself determines the amount of resistance to deformation of the rubber under compression.

CROSSING THE BAR

Sunset and evening star,
And one clear call for me.
And may there be no moaning of the bar,
When I put out to sea

But such a tide as moving seems asleep,
Too full for sound and foam,
When that which drew from out the boundless deep
Turns again home.

Twilight and evening bell,
And after that the dark!
And may there be no sadness of farewell,
When I embark;

For tho' from out our bourne of time and place
The flood may bear me far,
I hope to see my Pilot face to face
When I have crossed the bar.
—*Alfred Tennyson*

All of this work has been done in an effort to make the planes more comfortable by absorbing the vibrations set up. Progress is the result obtained through the solution of these problems.

New Electric Welding Unit

After several years of experimental work, a machine has been developed which will weld tubing of much heavier wall thickness than has heretofore been possible and up to 5 inches in diameter. Sizes formerly direct welded in this manner ranged from No. 26 to No. 11 gauge. The new unit electrically welds tubing to ¼ inches in thickness, increasing the wall range to No. 3 gauge, all intermediate gauges being included.

The new machine is so constructed that large coils of flat steel stock are fed into the forming rolls to be formed cold into a tube. This passes directly under the electrodes where fusion takes place without the addition of foreign metal at a speed of approximately 80 feet of tubing per minute. The welding burr is eliminated and the weld is almost imperceptible. The process is practically continuous and is not only much faster but produces a better finished product from the standpoint of strength and appearance. Welding power for the machine is drawn from the lines at 2300 volts. When operated at full capacity, over 1200 kilowatts of electrical power is concentrated continuously in a spot no larger than the eraser on a pencil.

Continuous testing takes place, samples being expanded until the wall fractures. This fracture must occur at some point other than the weld to allow the welding machine to continue in production. Ductility and hardness tests insure correct temper.

The new machine permits exceptional uniformity of wall thickness, a tolerance of .004 to .008 inches plus or minus being observed and in some special cases even less.

Soldering Iron Uses Gas

A new means of heating the soldering iron has been recently developed and placed on the market. The heat source is natural or artificial gas mixed with low pressure air by means of a needle valve. The gases pass through a rubber hose to the handle of the torch. The copper tip may be brought to a red heat three to five minutes after lighting and the desired temperature may be secured by regulating the needle valve.

As the copper tip is not exposed to open flame, cleaning and retinning of the tip is seldom required. It may, however, be quickly changed, being merely screwed on the stainless steel tip. The heat deflector is an integral part of the tool.

Such an iron will be able to compete with electricity in cost of operation, for the three pound tip requires only 6 or 7 cubic feet of gas per hour, and the five pound 8 or 9 cubic feet. This soldering iron may be also used as a torch with good results.

Electricity Direct From Sunlight

It is generally known what sunlight is and that its unlimited energy is now going to waste. Recently a new cell was devised in an effort to take advantage of this vast source of energy. By means of this cell sunlight can be converted into electrical energy at a price that may, in time, compete with present hydroelectric installations.

The new cell is a form of the photo-electric type, the difference being in the metallic layers of the cell. The copper oxide cell which has been known for many years was a forerunner of the new type, but it was not a successful converter from an economical standpoint.

Silver selenide is the best substance, as yet developed, for converting light into electricity. A sheet of metal is covered with a thin layer of silver selenide which in turn is coated with a very thin transparent layer of a second metal.

Light passing through the transparent film sets up a current between the two layers of the different metals. However, if a similar setup is used with copper oxide between two layers of copper, only about one-hundredth of the current of the former method is obtained. In a recent experiment, a copper cell operated a motor by dull sunlight for many months.

One type of cell uses a coil of copper wire pressed on top of the oxide by a plate of glass which acts as the upper electrode. The new device, however, deposits a thin layer of copper by cathodic sputtering on the cuprous substance. This results in a greater current and a greater efficiency is obtained.

The new photo-cell development promises an entirely new method of power production. The engineer welcomes such an enterprise if its cost can be made suitable to industry. At present such an installation is out of reason because of its cost, though the maintenance and operating expense is almost negligible.

Steam Driven Buses

A possible substitute for the gasoline driven type of bus now in use will shortly be given a trial under passenger service conditions. These steam-propelled buses are hailed by their promoters and by commerce experts as a great addition to the ever perplexing problem of transportation.

Outwardly the bus will differ very little from those now in use but it is claimed that the quiet running and smooth silent acceleration will distinguish it from other vehicles.

The boiler consists of a series of coiled tubes and has been placed in the space previously occupied by the gasoline motor. A condenser to return the exhaust steam to water for renewing the boiler supply has been placed in the position of the radiator. The cylinders are packed and encased to prevent the escape of heat.

OPPORTUNITY

Master of human destinies am I.
Fame, love, and fortune in my footsteps wait.
Cities and fields I walk; I penetrate
Deserts and seas remote, and, passing by
Hovel, and mart, and palace, soon or late
I knock unbidden, once at every gate!
If sleeping, wake—if feasting, rise before
I turn away. It is the hour of fate,
And they who follow me reach every state
Mortals desire, and conquer every foe
Save death; but those who doubt or hesitate,
Condemned to failure, penury and woe,
Seek me in vain and uselessly implore—
I answer not, and I return no more.
—*John James Ingalls*

The speed is controlled by a throttle wheel which can be operated by the thumb. There is to be no gear-shift lever, reversing being done by means of a foot pedal.

Automatic Feed-Water Unit

A new feed water unit, suitable for boiler capacities from 50 to 2,150 square feet and for working pressures up to 125 pounds, has recently been devised. This unit consists of a receiving tank, pump, motor assembly, and automatic control.

The tank receives condensate from return lines as well as the necessary make-up water from the city mains or other source of supply. Automatic operation of the pumping unit is controlled by a water-level control mounted on the boiler. This control is equipped with a float - actuated mercury switch for normal operation, a safety control water cutout switch, and a standard water-gage glass. A sediment strainer is also an integral part of the control.

Asphalt-Aluminum Paint

Asphalt dispersed in a volatile solvent, plus flake aluminum, constitutes a new asphalt base paint recently put on the market. The flake aluminum is prepared by stamping, after which it is polished. A thin film of solvent-repelling polishing agent, which remains on the aluminum flakes, causes them to work their way to the outer surface of the applied coating before the asphalt begins to harden. The finish is, therefore, bright and highly reflecting, having at the same time great covering power and long life.

One coat of this material will ordinarily suffice, regardless of the previous color of the wood, metal, or other material to which the paint is applied. The substance is also very efficient when used as a priming coat for other paints. It may be used for both interior and exterior work and is particularly effective in reducing evaporation from metal tanks, due to its reflectivity. The mixture has excellent resistance against corrosive atmospheres.

Smoke Washers

In order to prevent the discharge of fly ash from coal-fired plants, soot from oil fired installations as well as sulphurous flumes common to both, a down jet, spray type washer for installation on boiler stacks has been put on the market.

An inverted cone is fastened to the top of the stack with a dome-shaped canopy, slightly larger in diameter than the stack, supported centrally above it. Two spray coils are attached on the inner side and near the lower edge of the canopy. Each coil is fitted with flat spray type nozzles so as to produce a thin circular curtain of water completely surrounding the stack. Thus the flue gases must pass through two curtains of water. To prevent any gas escaping between the nozzles or above the curtain, circular baffles are placed directly inside the spray coils.

A motor-driven centrifugal pump is used to maintain the 20 to 30 pound pressure required in the spray coils. The drain from the spray is led to a re-circulating screen tank, where, by means of

(Continued on page 146)

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The Rosenwald Museum of Science and Industry

(Continued from page 121)

industrial rise of modern Germany. Nor can we ignore its effect in strangling the rudigo industry of India or the madder-root industry of southern France.

So the rise of electricity from Thales to Thomas A. Edison will be traced technically if for no other reason than to show that while for centuries electricity was of no social and economic importance, yet that later a new social world was created by the discoveries of Morse, Bell, Edison, Siemens, and Marconi. The visitor will understand the significance of the transition period through which we are now passing. Our period is one in which electrical energy generated by twenty to even fifty central stations, located in a dozen states is pooled to form a great invisible reservoir which may be tapped at will so that an excess in one city may make good a deficiency in another. It will be made clear that our industrial centers are already beginning to disintegrate, that factories are being slowly transported from overcrowded cities to regions where land is cheaper, labor abundant, and where electrical energy is available. We become aware of the fact that we are in the midst of an electrical revolution and that like James Watt, the electrical engineer is today moulding society.

One after another the great inventions and discoveries will thus be taken up, first to be explained technically and then to be socially and economically integrated with their age. Thus, we must not be content with the working model of the first Otis Elevator. The museum must also show that the elevator made possible the Chicago and New York that we know, cities with structures towering to heights that still seem incredible to many a European. Certainly the museum must present the social problems that the skyscraper, the direct result of the elevator, has created. It must show that the elevator, the tall office building, hotel, apartment house, subway, and street railway are socially related to one another and this organic relationship must be brought out by models, paintings, motion pictures, and dioramas.

One of the most interesting features of the museum will be a street which will be easily ninety feet long and which will be divided into periods of time. In two minutes the visitor will walk from the seventeenth century to the twentieth. He will see a gentleman of Elizabethan London carried in a chair through the mud with link-boys to light the way home; he will note the absence of an adequate water supply and drainage system. As he steps into the next division it will strike him that oil lamps illuminate the darkness and that footway and carriage way are improved and so, as he walks on he will be impressed with the change brought by the introduction of gas and electricity, of water and sewer mains, and of better houses, all bearing an obvious technical relation to the improved street. Finally he enters a few feet of the Michigan Avenue of today with shop windows and streets brilliantly illuminated, with a hard, smooth asphalt beneath his feet and a roadway honey-combed with conduits for cables that deliver energy or convey messages.

THAT TIME OF YEAR

That time of year thou mayst in me behold
When yellow leaves, or none, or few, do hang
Upon those boughs which shake against the cold,
Bare ruin'd choirs, where late the sweet birds sang:

In me thou see'st the twilight of such day
As after sunset fadeth in the west,
Which by and by black night doth take away,
Death's second self, that seals up all in rest:

In me thou see'st the glowing of such fire
That on the ashes of his youth doth lie,
As the death-bed whereon it must expire,
Consum'd with that which it was nourish'd by:

—This though perceiv'st which makes thy love more strong,
To love that well which though must leave ere long.

—William Shakespeare

The temperament and mental needs of America are different from those of Europe. Accordingly, the Museum of Science and Industry must evolve its own methods in an effort to keep pace with the rapid transitions of America. The motion picture, for example, still plays a minor part in Europe, partly through lack of funds and partly through lack of a sturdy and faultless daylight projector. In the Museum of Science and Industry scores of motion pictures machines will be found, operated for the most by push buttons. It will be their function to clarify the obscurities of radio and X-rays, the Einstein theory, the relativity of the wheeling of the planets. With their aid the public will be photographically transported into steel mills and factories, to learn how principles elucidated by moving models have been there industriously applied. Some of the films will talk in sound-proof booths and thus relieve attendance of much lecturing.

The need of an educational institution such as the Rosenwald Museum of Science and Industry is apparent. Edison and Westinghouse had to acquire their technical knowledge as best they could at a time when there were few, if any, engineering schools in this country. Imagine, then, the mental stimulus that future Edisons and Westinghouses will receive from such an institution as The Rosenwald Museum of Science and Industry. Many a lad will be brought to discover that engineering is his true bent. The advanced engineer and the student of industry will likewise profit by an examination of the museum's collections. Science, engineering, and industry are here a complex in their interrelationship for it is difficult to grasp the causes and significance of their rapid progress.

By illustration of the principles of science and the vital applications thereof, a real concept of engineering in its most accurate sense will be available to young men about to choose a profession. To the general public the project will mean a new understanding and revelation of what it has perhaps been considering in the light of a false perspective.

There can be no doubt that Mr. Julius Rosenwald, by his great generosity in presenting this museum to the city of Chicago, has erected for himself the noblest of monuments and conferred upon the city he loved so well a boon, the blessings of which cannot be over-estimated. Coming generations will bless his name for launching and endowing this great project.

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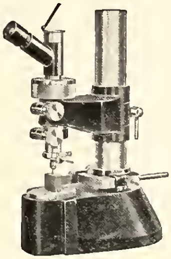

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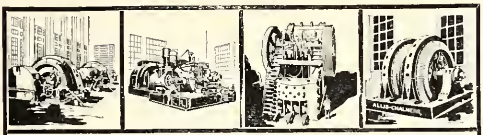

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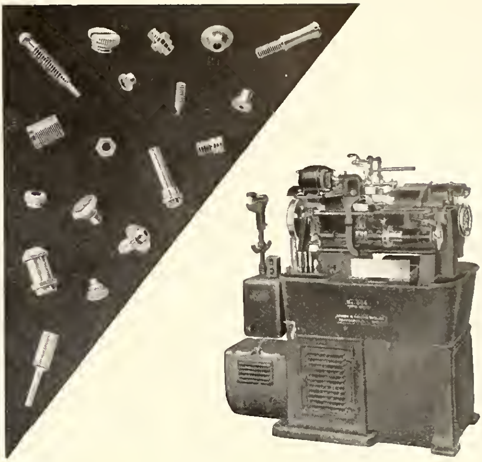

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Radiobeacons for Airways

(Continued from page 119)

other with A. The indication of the flying course was given by an interlock of the two letters to make a long dash audible. The visual system is based on the simultaneous transmission of waves modulated to different frequencies, that is, one loop might radiate a carrier modulated by 100 cycles and the other by a modulation frequency of 300 cycles.

For analysis of the radiated pattern, the wave from each antenna may be resolved into a carrier and two side bands as shown in Figure 3 (a). The carriers for both antennae are of the same radio frequency. If they are in phase, they may be combined into a single carrier with maximum intensity along the bisector of the angle between the two antennas. The side bands, being of different frequency, do not combine so that the maximum intensity of each is along the plane of its aerial. The peculiarities of the loop are present here just as they had been in the earlier discussion of its principles. Now we come to the unique characteristic of the visual system. Let us assume some sort of a device connected to the receiver of the airplane which will indicate to the eye preponderance of one carrier frequency over another. Since it is connected to the output, the indicator must necessarily be actuated by a beat note obtained from combination of the side-band frequency with the radio-frequency carrier rectified by the detector. Due to this effect and to the characteristics of a vacuum-tube detector, the received pattern will be quite different from the beacon figure. It is shown in Figure 3 (b). It is seen that there are neutral regions where neither frequency is more obvious. Through these areas lies the airway course.

The success of such an arrangement is dependent upon the efficiency and simplicity of what we have so far called the indicator, the instrument that is the sole evidence of direction to the pilot. The needs are met by the tuned-reed type of visual indicator, which is quite similar in principle to the commercial frequency meter used in alternating current work. It consists of two steel strips fastened at one end and free to vibrate at the other in the field of small electromagnets which are connected to the receiving set. By mechanical design, these vibrating reeds are made so that each will have a natural frequency which allows it to respond to one of the beacon modulation frequencies. Each reed carries a white tab on its free end, so that when it is vibrating the observer sees a white line for each of the stripes. When these two lines are equal in length, it is evident that the signal strength of both modulations is the same, indicating the course. If the plane deviates to one side the vibration amplitude of one of the reeds will increase due to the increase in signal intensity from one of the aerials. So we have this simple pilot's rule: "Longest reed shows side off course."

She Walks in Beauty

She walks in beauty, light the night
Of cloudless climes and starry skies;
And all that's best of dark and bright
Meet in her aspect and her eyes;
Thus mellowed to that tender light
Which heaven to gaudy day denies.

One shade the more, one ray the less,
Had half-impaired the nameless grace
Which waves in every raven tress,
Or softly lightens o'er her face;
Where thoughts serenely sweet express
How pure, how dear their dwelling place.

Figure 4 is a diagram of the double-modulation beacon. It consists of two 1000 watt tubes modulated at 65 cycles and 86.7 cycles, respectively, and excited from a smaller tube oscillating at a frequency of 290 kilocycles. The antenna system is identical with that previously described for the aural radio range. In the earlier arrangements, considerable difficulty was experienced due to the necessity of keeping the modulation frequencies constant within narrow limits. This was brought about by the fact that the vibrating reeds were themselves sharply tuned. It was also found that one frequency often underwent a different percentage change than the other, with consequent shifting of the beacon course. The first of these difficulties was remedied satisfactorily by broadening the resonance curves of the vibrating reeds by changing their design. The second obstacle was made insignificant by rigidly coupling the two alternators supplying modulation frequency and running them both from the same motor. Variations in motor speed thus result in the same percentage variation in the two modulation frequencies. As installed, one alternator has six poles, the other eight, and the speed of the motor is 1300 r.p.m., resulting in frequencies of 65 and 86.7 cycles, respectively.

In applying this type of range to the airways it is necessary to have available some means of shifting the courses from their 90° relationship as has been pointed out in connection with the aural radiobeacon. As a basis there are four courses in place of the two discussed in the analysis. The additional lanes are obtained by advancing the phase of one of the carrier-frequency currents 90° ahead of the other. This is the purpose of the inductance and capacity in the supply leads from the oscillator in Figure 4. One method of shifting the four beacon courses from their 90° space relationship is to reduce the percentage modulation of one amplifier branch. A reduction in signal strength follows, but the courses may be separated by any angle from 60° to 120°, still allowing direction indications back to the course for a deviation of 20° either side of it. A second method is the use of a vertical antenna to supply a circular radiation in addition to the loops. The results are essentially the same as for the first method. By combining the two it becomes possible to dispose of three of the four courses at practically any desired angles. Still further extensions and combinations have been developed to make the system highly feasible where four courses emanate from an airport.

The disadvantages of the aural radio range have been overcome. Here is a system that presupposes no skill in its use on the part of the pilot, that obviates the need for his wearing headphones, and, that due to the selectivity of the reeds, is almost immune from atmospheric disturbances. The pilot is guided along a regularly flown route planned for minimum hazards such as obstructions and rough ground conditions. If he leaves this course, a glance conveys to him the extent of deviation and the way back to the course. He is informed of his arrival directly over the destination, a point of zero signal strength, by the cessation of reed vibration. The equipment on the plane is simple and rugged. Ground stations may be erected and maintained with no particular difficulties. This system is admirably suited to the present requirements of civil air transportation and has proved highly successful in test flights made recently on existing airways.

The Bureau of Standards has gone ahead to meet the needs of the country five years hence. Expecting that large cities will be the junction of more and more airways, an extension of the double-modulation beacon system is being developed so that a single transmitter may be capable of serving twelve courses simultaneously. This is to be done by the addition of a third modulation frequency and amplifier system, coupled through a six-coil goniometer to the usual pair of antennae. The course indicator has already been altered, using three reeds with a special shutter arrangement to expose the proper two for a given course. The triple modulation beacon system is just emerging from the experimental stage and in a few years it may be expected to find its place at the larger airports. However, more than 90 per cent of the beacons will for a long time be of the earlier type since air routes from one large city to another must necessarily pass through dozens of smaller population centers. At each of these, a four-course beacon is indicated.

It requires little imagination to foresee the contribution which the radiobeacon will make to civil transportation. It has already been shown by months of test flights that flying will become more safe, more reliable, and more rapid in proportion as the air routes are marked out by the remarkable radio lane. Perhaps the derision of the romantic in aviation which was so confidently expressed in the introduction was hasty, even sophomoric. How can one disregard the romance behind the words, "Longest reed shows side off course?"

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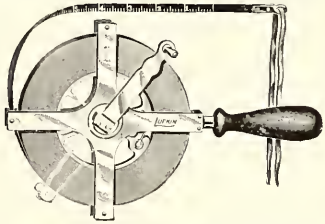

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The Development of the Illinois Waterway

(Continued from page 116)

both the up and downstream ends of the locks with the exception of one used at Lockport. Here a different type of gate, the lift gate, is used at one end of the lock. This small modern lock was built by the Sanitary District of Chicago to connect the Chicago Drainage Canal with the old Illinois and Michigan Canal. This lock must be retained for the new waterway as the remaining lock site is so restricted in width that, adjoining the lock, there is not sufficient area for the mass of concrete required for the thrust of a mitering gate. Two gates similar in construction and operation are installed, one being for emergency purposes.

In case of accidents by ramming the lock gates, movable dams have been provided above all locks with the exception of the lift gate at Lockport. By simply opening these movable dams the water can be drawn down almost to the level of the upper miter sill. However, at the summit level at Lockport it is not possible to so draw down the pool due to the restricted area there. An emergency gate has, therefore, been designed to be installed upstream from the upper lock gate. In case any of the gates of this lock are carried away, an emergency dam can be raised and the flow of water reduced.

The principle requirements of a lock filling and emptying system, due regard being given to economy, are that it shall permit equalization of levels in a reasonable time, will not create dangerous water disturbances in the locks or approaches, and will not allow excessive waste through leakage.

A large circular culvert in each lock was adopted, as the economy of such a design has been demonstrated by past experience. Extensive study revealed the fact that two culverts 12 feet in diameter would insure equalization of levels in seven to twelve minutes, depending upon the location of the lock and subject to the limitation in equalization of 4 feet vertically per minute.

The systems of the Soo and Panama Canals are examples of attempts to secure a uniform distribution of flow into the lock chamber. Investigation showed that the systems employed in the Soo and Panama locks possess no material advantages commensurate with their additional cost over the system adopted for the Illinois canal. The latter employs longitudinal culverts in the lock walls with horizontal openings directly into the lock chamber immediately above the floor. Vertical jets create a greater disturbance in shallow water and cause violent movements of boats and fleets of barges which cannot be foreseen and provided for. That these disturbances occur is shown constantly in the operation of the Keokuk lock on the Mississippi, the filling system of which is similar to the Panama system.

Concord Hymn

By the rude bridge that arched the flood
Their flag to April's breeze unfurled,
Here once the embattled farmers stood,
And fired the shot heard round the world.

The foe long since in silence slept;
Alike the conqueror silent sleeps;
And time the ruined bridge has swept
Down the dark stream which seaward creeps.

On this green bank, by this soft stream,
We set today a votive stone;
That memory may their deed redeem,
When, like our sires, our sons are gone.

Spirit, that made those spirits dare
To die, and leave their children free,
Bid Time and Nature gently spare
The shaft we raise to them and thee.

—*Ralph Waldo Emerson*

The correct design of a lock filling system has until recent years been a disputed question among canal and hydraulic engineers, owing to the lack of experimental data. The maximum flow is from the openings nearest the lower end of the chamber and the minimum flow is from the upstream openings. Such a condition of flow induces a current and drift of boats towards the upper gates when filling and the lower gates when emptying, which is very objectionable owing to the danger of damaging the gates. With the arrangement which has been devised for the Illinois locks, the drift from each group of openings (at each end) will be approximately equal in intensity and when filling will be toward the center of the lock, thus automatically centering the vessel in the lock chamber so that it will not drift toward the miter gates. When emptying a chamber, the drift will be away from the center, but with large boats or fleets of barges the drift effects from the two groups will tend to neutralize each other. Furthermore, a good distribution in emptying is not so essential, because the violent water disturbances are due to the dissipation of the energy of the flowing water. When emptying a lock, this dissipation of energy takes place in the culverts and not in the lock chamber as is the case when filling.

Miter-type gates are being used on all of the locks with the exception of the gate at Lockport as was mentioned previously. Each gate will consist of two leaves 65 feet long and 7 feet wide. They vary in height from 20 to 59 feet and in weight from 90 to 320 tons.

A series of horizontal girders is used for the gates. In addition, they are stiffened by five sets of vertical diaphragms and by adjustable diagonal tension rods on the upstream face. The gate is filled in with a lead-antimony alloy to give it a firm bearing. In regard to water tight compartments for floatation, it was found desirable to include air chambers, thus relieving partly at least, the weight from the gate pintles.

No other kind of gate other than the miter was considered for use, as this type has long been the standard for canals and has given excellent satisfaction in operation and maintenance. The operating machinery of these gates is by necessity massive but, nevertheless, very intricate. They have been designed so that an ideal motion will be imparted to the gate, that is, slow speed of the gate at the ends of travel and high speed at the middle portion of movement. The force required to move a gate depends mainly upon the vertical area which is submerged during operation, as the motion causes a difference in water level on the two sides of the gate.

To provide for the expected flood in the river, it is necessary to furnish some sort of a movable gate to pass the excess water. Several varieties were studied including the shutter, Taintor, and the Stoney gate types. Eventually, the Taintor gate type was selected. This gate consists of a cylindrical surface between piers resting on a horizontal axis, with its edge in contact with the upper surface of a submerged weir. The whole is counterweighted so that it may be raised by mechanism to overcome the friction. The final decision in favor of the Taintor gate type in preference to the Stoney type was on account of superior ease in installation and operation.

To provide access to the gate in the case of repair or replacement, a movable coffer dam is provided in sections to be placed just in front of the gate. Above water a strong horizontal steel beam fits into notches in the abutment. Between this and the concrete apron below, a series of steel needle-beams are placed, entirely filling the opening. Thus, the space between the cofferdam and the Taintor gates may be drained of water so that the necessary work on the main gate may be accomplished.

The dam is built of structural steel and is a portion of a cylinder rotating about a horizontal axis, the curved surface being upstream so that the pressure of the water is through the center of rotation. It is 30 feet long with an adjustable crest of 7 feet maximum variation. It is constructed to facilitate the movement of ice. Steam pipes prevent ice from forming about the hinges used on the gates.

There are twelve highway and street bridges across the present river channel that either will have to be rebuilt entirely or equipped with a draw span across the channel. Six of these bridges will be rolling lift bascule structures of the Scherzer type. The others will be of the vertical lift type. In addition, there are five railroad bridges crossing the river at present in which draw spans will have to be constructed.

Upon the completion of this canal project, boats of large dimensions and capacity navigating the Mississippi River system may make direct connection with Lake Michigan at Chicago. The character of water craft suitable for use on the Illinois Waterway and Mississippi River system is receiving considerable attention from engineers and transportation experts.

The subject of proper terminals is of increasing importance and is demanding the attention of private interests and public officials of the cities located on the navigable waters of the Middle West. Studies are being made by various municipalities with a view to determining the type of terminals that suit best their respective conditions and requirements.

Chicago will be the most important port of the Illinois Waterway and will require a vast amount of terminal and harbor improvement to care for the barge shipping which is expected to develop. While the tonnage of the Chicago Harbor, which includes only the Chicago River and its connecting channels, has fallen off during the past fifteen years due to a lack of terminal facilities, the tonnage of the Chicago Terminal District has shown a greater rate of increase than any other harbor on the Great Lakes.

Upon viewing the massive work which has already been accomplished and the elaborate plans which are to be carried out, it is only to be expected that the Illinois Waterway, when completed, will be one of the greatest improvements ever brought about in this country. It is expected that the Illinois Waterway will form an important link between the north and the south, and that its future usefulness will fully justify the extensive outlay of resources, money, and time.

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Engineering News

(Continued from page 138)

screens and baffles, the solid particles are precipitated and the water is re-circulated through the nozzles by the pump. The only labor that is involved is the removal of the solids from the tank at intervals and the occasional cleaning of the screens. The washer is equally well adapted to brick as well as steel stacks.

New Photo Flash Lamp Developed

A fireless, smokeless, odorless, and noiseless photographic flash lamp has recently been developed. The flash is confined entirely within a bulb, with resulting advantages that are expected to revolutionize flashlight photography. Requiring only a one-hundredth of a second to act, and being without hazard, it will make possible the taking of flashlight photographs in places heretofore practically impossible to "shoot", such as in trains, airships, and theatres, under water, and by insurance companies requiring night photographs under all weather conditions.

The lamp consists of a clear bulb of standard design, with the flashlight filament coated with a special preparation, and with a quantity of very thin aluminum foil in crumpled sheet form within the bulb. The bulb is oxygen-filled. When the circuit is closed, the filament is lighted and this, in turn, lights the foil. The lamp operates on any 115-volt house supply, or with dry, storage, or flashlight batteries. A new lamp is needed for each flash.

Fire hazards, danger of explosion, and their attending damage of human injury, sometimes caused in connection with flashlight photography, are passing into oblivion with the use of the new photoflash lamp—a discovery by which an ordinary incandescent lamp bulb confines and tames a four million candlepower flash of lightning.

Like the powerful genie, imprisoned in a glass bottle that the fabled fisherman found in the sea, this new lamp confines potential light so great that when released, it produces a quantity and quality of illumination which makes flashlight photography easy, simple, and clear.

The danger from the use of flashlight powder induces photographers — particularly in the amateur field—to use the photoflash lamp. Home furnishings or other inflammable surroundings cannot be ignited or damaged from this lamp. It produces no flame and, of course, no smoke; the glass confines the chemical reactions and all residue. A flash of brilliant white light, ten thousand times brighter than the ordinary home lighting lamp produces, occurs so quickly that one may easily photograph people in action and rapidly moving objects.

Invictus

Out of the night that covers me,
Black as the pit from pole to pole,
I thank whatever gods may be
For my unconquerable soul.

In the fell clutch of circumstance
I have not winced nor cried aloud.
Under the bludgeonings of chance
My head is bloody, but unbowed.

Beyond this place of wrath and tears
Looms but the horror of the shade,
And yet the menace of the years
Finds, and shall find me, unafraid.

It matters not how strait the gate,
How charged with punishments the scroll,
I am the master of my fate;
I am the captain of my soul.

—William Ernest Henley

Oil-Operated Bleeder-Line Check Valves

A swing check valve with oil-operating cylinders has recently been introduced for use in turbine bleeder lines and similar services where an automatic or positive stop of reverse flow is required.

This valve is installed in the bleeder line at a convenient point adjacent to the turbine. High pressure oil is supplied from the main lubricating system of the turbine or from an independent source. The oil is passed through a three-way valve connected to the emergency overspeed governor of the turbine. When this governor operates, the turbine throttle valve and the oil-trip valve are tripped shut. This relieves the oil pressure from below the piston, and the spring in the valve cylinder forces the piston and stem down closing the bleeder valve tight and preventing back flow of low pressure steam through the extraction line. Drain connections are provided to carry off any oil that leaks past the piston or collects on the upper cylinder cover.

A New Force in Industry

(Continued from page 123)

Two methods of recovery are possible — absorbtion and adsorbtion. In the absorbtion method the solvent is absorbed in a hydrocarbon of a high boiling point, and is then recovered by distilling directly by steam. This method is expensive in both inital cost and current expense.

The adsorbtion method uses either active charcoal or silica gel. A disadvantage of charcoal is that it is highly combustible and magnifies the hazards which are already present in the handling of the solvents. The carbon pores also get clogged with higher boiling hydrocarbons which cannot be removed.

The usual silica gel unit has two adsorbers and the necessary auxiliary equipment. The vapor being recovered is precooled and then stripped of the solvent and moisture by passing over beds of the gel. Steam is passed through the adsorber to recover the solvent.

Catalysis

In the contact process for the manufacture of sulfuric acid, platinum is the catalyst, being usually used on a catalyst carrier such as magnesium sulfate, asbestos, or silica gel.

Since catalysis depends on the amount of catalyst exposed, it would seem that silica gel with its enormous surface area would be ideal. A plant which has been in operation for a year shows that only 80 per cent of the investment in platinum is needed when this new carrier is used. Last year over 130,000 tons of sulfuric acid were made using silica gel as a carrier for the platinum. No great amount of work has been done on the use of the gel in other catalytic actions.

In Conclusion

The fields which silica gel has invaded are many, but the fields in which it probably will succeed are limited. Solvent recovery is probably the most promising and yet it has not been attempted commercially in this country. Three installations in Europe have shown good results. Refrigeration and air conditioning are the next most important in the order named. The others, although interesting to speculate on and quick to catch the imagination, do not at the present time appear to present any serious problem for the competitors in those fields.

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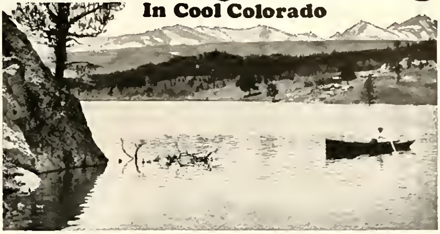
Study Engineering
In Cool Colorado



The Colorado School of Mines is located in Golden at the very foot of the Rocky Mountains. It is but twelve miles by paved road to the capital city of Denver, and but an hour's drive to the great Continental Divide, with streams and forests and snow-capped peaks rising to the sky.

The Summer School Engineers

Basic engineering courses in Mathematics, Chemistry, Physics, English and Design; Courses in Assaying, Geology, Analytical Mechanics, Graphic Statics, Strength of Materials, Thermodynamics, Physical Chemistry, and Plane and Mine Surveying; Preparatory subjects, for students deficient in entrance requirements, Advanced Algebra, Solid Geometry, Chemistry and Physics, are offered at the Colorado School of Mines Summer Session from

July 6 to August 28, 1931

This summer session is given especially for students who wish to make up work or to secure additional credits. All work is conducted by the regular faculty of the School of Mines. For complete description of class room courses, and field work offered in the summer session, write to the Registrar for "Quarterly Group L-3."

Colorado School of Mines **Golden, Colorado**
School of Mineral Industries

Summoning a Ghost to your bidding

The chemist Van Helmont in 1609 discovered an invisible substance, an emanation from coal, that he named "geist," meaning ghost, shortened in English to gas.

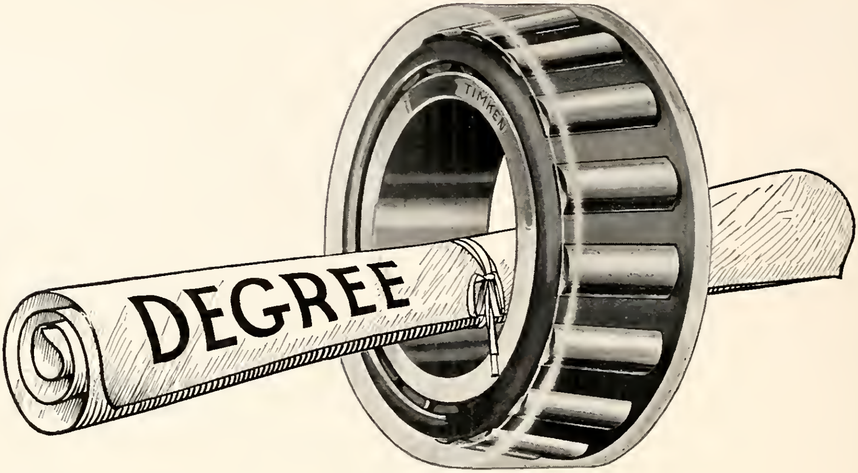
Only now do its miraculous possibilities begin to be glimpsed. Only now can modern industry, like a latter-day Aladdin rubbing his lamp to summon a vaporous genii, turn a valve and order this Ghost to any one of a hundred tasks.

From the beginning, the problem was one of piping. When Crane Co., a half century ago, set itself to develop and produce the right materials for every gas and oil purpose, it began an incalculably valuable contribution to the solution of problems that had held back the gas industry since the Chinese used hollow bamboo.

So in the development of the natural and manufactured gas industry, as in practically every other industry, the Crane line of valves, fittings, fabricated piping, and specialities have played an important part. No matter what branch of industry you enter, you will find Crane materials playing a similarly important part.

Valves **CRANE** *Fittings*

PIPING MATERIALS TO CONVEY AND CONTROL STEAM, LIQUIDS, OIL, GAS, CHEMICALS
CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO
NEW YORK OFFICES: 23 W. 44TH STREET
Branches and Sales Offices in Two Hundred Cities



Where college days end, Opportunity begins

Student engineers who graduate this year will soon be called upon to use their knowledge for the benefit of Industry, either in the designing of machinery or in selecting equipment to meet advanced production demands.

No matter which of these responsibilities may ultimately become yours, you will find in Timken Bearings one of your most powerful weapons with which to fight friction; power and lubricant wastage; inefficient operation; excessive maintenance expense and rapid depreciation.

Whatever you require anti-friction bearings to do, Timkens will do with utmost effectiveness.

Because of Timken tapered construction, Timken positively aligned rolls and Timken-made steel, they carry all types of loads—all radial, all thrust or both together in any combination.

Industry has signified its approval of Timken Bearings by selecting them for its toughest jobs in all types of machinery. The Timken Roller Bearing Co., Canton, O.

TIMKEN *Tapered Roller* **BEARINGS**

GLUE

.... In Industry

THE manufacture of glue is an industry as old as the ages. The pages of history disclose, three thousand years ago, the cabinet makers of ancient Egypt laboriously putting together the various parts of their handicraft with a crude form of glue, made under most primitive methods.

3000 years ago . . . . Meanwhile the processes of evolution have transformed ancient Egypt into the modern world; research and science has made commonplace to us today that which would have been miraculous in ancient or medieval times; production and marketing methods have advanced to a basis of scientific control;—but glue and glue-making were not a part of this transition.

Thru the ages, glue remained glue, with little regard for the raw material from which it came and the quality of the finished product.

Then a consciousness was awakened to the difference between glues made from the hides of animals and glues made from their bones. Then, gradually, users began to make certain crude tests of various elementary qualities, but these tests relied primarily on the physical senses, and were usually unreliable.

Only a few years ago, comparatively, was glue finally lifted out of crude speculation as to quality and elevated to an exact scientific method of grade measurement. The laboratories of Armour and Company, in cooperation with one other laboratory, were the pioneers who developed the new methods that have since been recognized the world over . . . . and indeed have recently been accepted as standard by the United States Government.

Armour and Company has also pioneered in adapting the form of glue more specifically to the user's needs. For generations, glue was delivered to the user in a flake form. Then came ground glue—only comparatively recently, however. This speeded up his production and was, in many cases, much more practical for his own purpose. Within the last decade, a new process has been invented. It gives the manufacturer glue in the form of a small pearl, combining all of the advantages of both flake and ground glue in a product that permits a further speeding up of production and at the same time guarantees a cleaner and purer product.

Armour and Company were the first to introduce Pearl Glue on a wide scale in this Country and at the present time is the only manufacturer from whom an appreciable supply of this glue is available.

Likewise in marketing practice Armour and Company have left the beaten paths to lead with new ideas.

A staff of trained chemists is maintained for the purpose of contributing the latest thought on good and economical glue practice. Scores of special problems weekly find their way from the manufacturing field to the Armour Laboratories, and painstaking reports are returned giving constructive help.

Out in the field, in addition, Armour and Company maintains chemical engineers who go wherever they are needed, on request, to analyze plant equipment, gluing procedure, and adaptation of grade of glue. Their sole purpose is to give assistance in improvement of finished quality or reduction of manufacturing cost.

So to the industrial engineer and to the student who seeks to bring the wisdom and logic of science to the performance of the task in hand, we say:

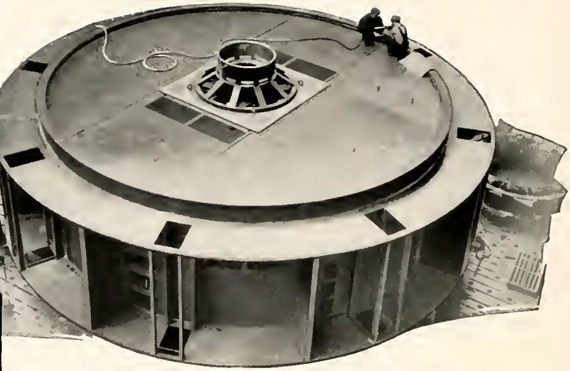
If it involves the use of glue, let our technical service give you the benefit of a prolonged and varied experience. Take advantage of our numerous resources which are always available to you.

ARMOUR GLUE WORKS

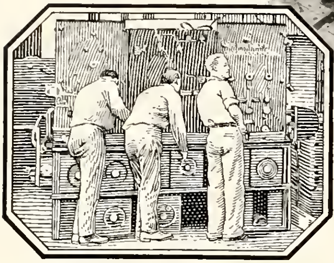
Owned and Operated By

ARMOUR AND COMPANY

1355 W. 31st St., Chicago, Ill.



56,250-kv-a. hydroelectric generator now being installed at the Ariel Plant of the Northwest Electric Company, on "test" before being shipped



One Power Giant for a *Million* Lamps

WHEN the waters of the great Northwest turn the wheels of this vast machine—and at only two revolutions per second—enough energy will be furnished to light a million lamps. The huge 56,250-kv-a. hydroelectric generator is 37 feet in diameter and weighs 440 tons. After being set up, this generator was balanced, tested for losses and overspeed, and was adjusted—all by recruit engineering graduates, supervised by experienced "Heads of Test."

Each year many college men discard their caps and gowns for the experience to be gained by actual test of major G-E apparatus in the different factories. Having completed this postgraduate course, which helps fit them for future responsible positions, these men will be largely intrusted with the research, design, planning, supervision of construction, and sale of this equipment.

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